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ABSTRACT

The standards, benchmarks, and indicators in this document were created to help Kansas educators develop local curricula and assessments, and to serve as the basis for the state assessments in mathematics. The committee strove to recommend high yet reasonable expectations for all students. There are four mathematics curricular standards: (1) number and computation; (2) algebra; (3) geometry; and (4) data. The standards are general statements of what a student should know and be able to do in mathematics. Each of the standards has a series of grade-level benchmarks that are listed below the respective standard. Below each benchmark is a list of indicators that identify what it means for a student to reach the benchmark. Benchmarks have been developed for grades 2, 4, 7, and 10. Four appendices contain information on mathematical reasoning and problem solving, a bibliography, a glossary, and a list of helpful resources. (Contains 15 references.) (ASK)

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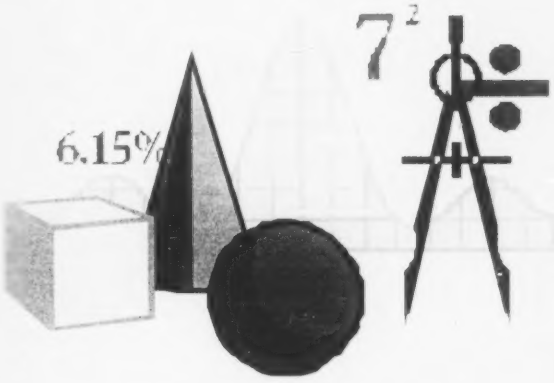
ED 442 668

Kansas

Curricular Standards for Mathematics



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Kansas State Board of Education
Revised March 1999

KSDE Kansas State Department of Education
120 S.E. 10th Avenue
Topeka, Kansas 66612-1182

April 12, 1999

To: Kansas Educators

Within the broad dialogue about school restructuring, the discussions related to the development of curriculum and to the teaching and learning process are among the most important. The Mathematics Standards contained in this document represent a continuation of the State Board of Education's efforts to set high performance expectations for the learning of all Kansas students.

Thanks to the efforts of dedicated educators, this document represents the State Board of Education's initiative to strengthen state standards and assessments. This document shall be a source of guidance to local curriculum development efforts. Also included within the document are the areas and levels to be tested.

I extend my deep appreciation to all educational stakeholders for their continued efforts to improve student learning in Kansas.

Sincerely,

Andy Tompkins
Commissioner of Education

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Kansas Curricular Standards for Mathematics
Table of Contents

Kansas Curricular Standards for Mathematics Writing Committee iii

Introduction to the Kansas Curricular Standards for Mathematics 1

- Mission Statement 1
- Vision Statement 1
- Purpose of this Document 1
- Prior History 1
- The Revision Process 1

Format of the Kansas Curricular Standards 3

- Standards, Benchmarks and Indicators 3
- Grade Levels Where Benchmarks and Indicators Have Been Developed 3
- Special Note Regarding Seventh and Tenth Grade Benchmarks and Indicators 4
- Definitions Which Will Be Helpful In Understanding the Document 5

Uses of this Document 7

- Development of Local Curriculum and Assessments 7
- Development of the Kansas Mathematics Assessments 7
  - Grade Levels to be Assessed 7
  - Kansas Assessment Scores to be Reported 7
  - The Use of Calculators on Kansas Mathematics Assessments 9
  - Prioritization of Indicators to be Assessed 9

Supplemental Documents 10

One Page Summary of the Standards and Benchmarks 11

Curricular Standards by Grade Level 13

- Second Grade Standards, Benchmarks and Indicators and Possible Kindergarten and First Grade Indicators 15
- Fourth Grade Standards, Benchmarks and Indicators and Possible Third Grade Indicators 29
- Seventh Grade Standards, Benchmarks and Indicators and Possible Fifth and Sixth Grade Indicators 43
- Tenth Grade Standards, Benchmarks and Indicators and Possible Eighth Grade Indicators 63

Curricular Standards by Standard and Benchmark 81

- Number and Computation
  - Number Sense 82
  - Number Systems and Their Properties 87
  - Estimation 94
  - Computation 99

continued on next page

Curricular Standards by Standard and Benchmark (continued from previous page)

Algebra
- Patterns 107
- Variables, Equations, and Inequalities 117
- Functions 123
- Models 127

Geometry
- Geometric Figures and Their Properties 136
- Measurement and Estimation 142
- Transformational Geometry 150
- Geometry from an Algebraic Perspective 155

Data
- Probability 160
- Statistics 164

Appendix 1 - Information on Mathematical Communication, Reasoning, and Problem Solving 174

Appendix 2 - Selected Bibliography 176

Appendix 3 - Glossary of Terms 177

Appendix 4 - Helpful Resources 186

The Kansas Curricular Standards for Mathematics Writing Committee

The writing committee would like to thank the more than 400 persons or groups who submitted written responses to the first, second, and fifth working drafts of this document as well as the more than 100 persons who provided input at public meetings held throughout the state. The committee thoughtfully read and considered each of the responses which were received and felt this input was invaluable to the development of this document.

In addition the committee would like to thank the teachers, school administrators, parents, and community members who have and will continue to work toward improving mathematics education in Kansas.

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Introduction to the *Kansas Curricular Standards for Mathematics*

Mission Statement

The mission of Kansas mathematics education is for all Kansas students to learn mathematical content and skills which are used to solve a variety of problems.

Vision Statement

The vision of mathematics education in Kansas is to work toward the following:

- Kansas mathematics education will be recognized as one of the premier programs in the United States.
- Kansas mathematics education will be equally effective for all students, irrespective of gender, race, or socioeconomic background.
- Kansas families will broadly recognize the importance of and be encouraged to participate actively in their child(ren)'s mathematics learning.
- Technology will be a fundamental part of mathematics teaching and learning.

The Purpose of this Document

The standards, benchmarks, and indicators in this document have been created to assist Kansas educators in developing local curricula and assessments, as well as to serve as the basis for the development of the state assessments in mathematics. The committee strove to recommend high, yet reasonable expectations for all students. High, yet reasonable expectations for all students are components of fairness in education. "All students" includes: those who choose to attend college; those who choose technical preparation; those from various socio-economic backgrounds; those who have been identified as gifted in the area of mathematics; those who have been identified with learning disabilities; those who have previously been successful with mathematics, and those who have struggled with mathematics sometime in the past.

Students may need additional support both within and outside the regular classroom to meet those expectations. Teachers should be given the professional development and resources necessary to enable them to help all students strive to meet or exceed these expectations. This may seem a daunting task, but the alternative is not acceptable.

Prior History

The Kansas State Board of Education developed and adopted the Kansas Mathematics Improvement Program in 1989. As part of that plan, *Kansas Mathematics Curriculum Standards* were developed by Kansas educators in 1990. A new Kansas mathematics assessment program began as a statewide pilot in 1991. In 1992, the Kansas legislature directed that further work be done in the development of the mathematics curriculum standards so that benchmarks would be established at a minimum of three grade levels. In 1993, the State Board adopted revised standards for mathematics. The *1993 Mathematics Curriculum Standards* then served as the basis of the Kansas Mathematics Assessment program through the end of the 1998-99 school year.

The Revision Process

At the August 1997 meeting of the Kansas State Board of Education, the State Board directed that academic standards committees composed of stakeholders from throughout Kansas were to be convened for each of

the curriculum areas defined by state law (reading, writing, mathematics, science, and social studies). The committees were charged to:

1) bring greater clarity and specificity to the standards to what teachers should teach and students should learn by the benchmark grade levels established by the committee.
2) review current state curricular standards.
3) prioritize the state curriculum standards to be assessed over time by the state assessments.
4) provide advice regarding the assessment of the state curricular standards, with the understanding that the State Board of Education has determined that there will be no state level performance assessments related to the standards which schools are required to administer.
5) consider and make recommendations regarding whether a fall assessment should be considered when the assessment schedule would allow.

The mathematics writing committee was convened in October 1997. Members met for more than thirty days. The draft writing subcommittee met for an additional seven days. Members of the committee reviewed various research articles, examples of mathematics curriculum standards from other states, reviews of the current *Kansas Mathematics Curriculum Standards* by various individuals and organizations, information from the Third International Mathematics and Science Study, and the comments of the testing experts who spoke at the State Board's August 1997 retreat. Because an earlier edition of the *Kansas Mathematics Curriculum Standards* had been used to guide curriculum, instruction, and assessment throughout the state since 1993, the committee felt it was very important to build upon existing efforts to improve mathematics education. The committee unanimously elected to use the 1993 Standards document as the basis of their work.

At their initial meeting, the writing committee reached consensus on the following revisions for the first draft of the revised *Kansas Curricular Standards for Mathematics* :

1) definitions of curriculum standards and grade level benchmarks.
2) format revisions which moved from a format based on outcomes to one which was based on standards and benchmarks.
3) format and language revisions which made the standards and the benchmarks easier for non-mathematics educators to understand, as well as aligning the mathematics standards document with standards documents from the other curriculum areas.
4) grade levels where the draft benchmarks were to be developed.
5) broad categories of curriculum content which were to be included in the standards.
6) expectations for students were to be high but reasonable to achieve.

During meetings in November and December of 1997, members of the mathematics committee and writing subcommittees continued to work to bring specificity and clarity to the benchmarks in the revised document by expanding or modifying the expectations outlined in the 1993 *Kansas Mathematics Curriculum Standards*. In January 1998, the first revised working draft was mailed to schools throughout the state to obtain feedback on the draft. At their two-day meeting in February 1998, the committee spent time reviewing and discussing the feedback from schools, revising grade level expectations, learning about and discussing various assessment issues, and brainstorming possible assessment priorities. By March, a second working draft was mailed to educators, community members, and professional organizations. Ten public meetings were also held in March throughout the state to receive public input on the second draft. Summaries of the public meetings and written feedback were compiled for the committee. At their March 1998 meeting, the Kansas State Board of Education also requested the committee to develop standards, indicators, and benchmarks for twelfth grade. In early April, the committee met for three days to review all of the written feedback and comments from each of the public meetings in order to create a third working draft. Grade level expectations were modified and further prioritization of benchmarks and indicators to be used in developing the Kansas Mathematics Assessments was completed. During mid-April, the third draft was submitted to the State Board's designated outside reviewer, Mid-Continent Regional Educational Laboratory, for review. In late April, the writing committee met for an additional two days to make revisions based on recommendations from McREL's review and to further prioritize indicators which would be used as the basis for assessment items on the revised Kansas Mathematics Assessments. This fourth working draft was prepared for submission to the State Board and discussed at their May meeting. At the

May meeting, the State Board agreed to accept the committee's recommendation that the draft Twelfth Grade Standards not be adopted at this time.

The State Board received the committee's fifth draft at their June 1998 meeting. The State Board did not take action to accept the *Kansas Curricular Standards for Mathematics* at that time.

In July of 1998, the writing committee was given these additional guidelines by the State Board:

1) The *mission statement* is to be changed to read as follows: *The mission of Kansas mathematics education is for all Kansas students to learn mathematical content and skills which are used to solve a variety of problems.*
2) The separate *application standard* is to be eliminated. The words "know and use" will be included within each of the four content standards. The word "use" will be defined in an appendix. (The definition will be based upon the wording of the indicators from the application standard.) This insures that the items on the state assessments reflect both the student's knowledge and the ability to use that knowledge.
3) In order to provide clarity to the field, *the phrasing of the standards*, benchmarks, and indicators are to use the word "and." The prioritization for assessment will determine if part or all of the indicator will be assessed on the state assessments.
4) The committee is directed to begin the process of developing *grade by grade standards* for grades K - 8, with the understanding that these are not to be a curriculum mandate, but suggestions on how schools can reach the benchmarks which will be assessed at grades 4, 7, and 10. Please note that the tenth grade standards will remain as the high school standards, as separate course standards are NOT to be developed.
5) *Calculator usage* is NOT to be allowed on any portion of the NEW fourth grade state assessment. The committee's original recommendations for calculator usage on the seventh and tenth grade will be followed. (Calculators will be allowed, although there will be a separate non-calculator portion on the seventh and tenth grade assessments.) A separate technology standard does NOT need to be developed. Calculator and technology use can remain in the *Standards*.
6) The committee's original recommendation of *reporting two subscale scores* (knowledge base and application) and a composite score at the individual student level was accepted.

After the July 1998 meeting of the State Board, the full writing committee reconvened to continue their work throughout the fall. Committee members held discussion sessions at the Kansas Association of Teacher of Mathematics annual meeting in October 1998. In early February 1999 the writing committee met for the last time to finalize the prioritization of the indicators to be included on the Kansas Mathematics Assessments. The committee's final recommendations, as presented in the seventh draft, were acted upon and approved at the March 1999 meeting of the Kansas State Board of Education. Revised Kansas Mathematics Assessments, based on these standards, are to be administered for the first time during the spring of 2000.

Format of the Kansas Curricular Standards for Mathematics

Standards, Benchmarks, and Indicators

There are four curricular standards for Mathematics - number and computation, algebra, geometry, and data. The standards are general statements of what a student should know and be able to do in mathematics. Each of the standards has a series of grade level benchmarks which are listed below the respective standard. These grade level benchmarks describe what a student should be able to do at the end of a specific grade level. Below each benchmark is a list of indicators which identify what it means for a student to meet the benchmark. The list of indicators is not meant to be all inclusive nor do they appear in a prioritized order.

Grade Levels Where Benchmarks and Indicators Have Been Developed

The writing committee determined that grade level benchmarks would be developed in the following grades: second grade, fourth grade, seventh grade, and tenth grade. Besides reviewing and revising fourth and

tenth grade outcomes from the 1993 Standards document, these decisions required the development of new second grade benchmarks, and the modification of the eighth grade outcomes into seventh grade benchmarks.

Even though benchmarks and indicators have been designated "by the end of" a specific grade level, it is NOT the committee's intent that only curriculum, instruction, and assessment in the grade levels where the Kansas Assessments will be given be modified to help a student meet the expectations listed in the indicators. Instead, it is the vision of the writing committee that there will be a local decision made on how local curriculum, instruction, and assessment will be organized throughout all grade levels to help a student meet these expectations. To assist schools in organizing their local curriculum, instruction, and assessments, the State Board directed the writing committee to develop possible indicators for kindergarten, first grade, third grade, fifth grade, sixth grade, and eighth grade. These additional indicators represent one of several ways in which mathematics curriculum, instruction, and assessment could be organized in grades K - 8, and tenth grade to help students reach the fourth, seventh, and tenth grade benchmarks.

The State Board accepted the writing committee's recommendation that an annual state assessment be given at fourth, seventh, and tenth grade. Those indicators which will serve as the basis for assessment item development at each of these grade levels have been identified. Please see the assessment section for a complete description of the prioritization.

A Special Note Regarding the Seventh and Tenth Grade Benchmarks and Indicators

In most schools across the state of Kansas, all seventh grade students and all tenth grade students are often not enrolled in the same mathematics course. Because the benchmarks and indicators corresponding to state assessments are designed for a specific grade level, it is important for readers to have a short description of what the committee members felt would be high but reasonable expectations for students at seventh and tenth grade levels. The seventh grade and tenth grade standards, benchmarks, and indicators are built around these understandings for student expectations.

By the end of seventh grade, a student should be proficient in selected concepts, procedures, and applications involving number and computation, algebra, geometry, and data. Middle school mathematics programs should provide all students with a strong foundation for the continued study of higher levels of mathematics. Such programs emphasize a broad range of challenging mathematical skills not limited to those traditionally considered as pre-algebra.

By the end of the tenth grade, a student should be proficient in selected concepts, procedures, and applications involving number and computation, algebra, geometry, and data. These skills can be learned within a wide variety of high school course options. Selections of indicators marked for the tenth grade assessment were made from skills associated with an algebra I course or its equivalent, plus additional skills which can be learned as a part of an algebra II course, a geometry course, or through an integrated approach with minimal curricular adjustments.

Definitions Which Will Be Helpful in Understanding the Document

Special Note: It is the intention of the writing committee that the mathematical vocabulary used in each of the standards, benchmarks, and indicators should be known and used by the teacher and the student at their respective grade level.

Standard: A curricular standard is a general statement of what a student should know and be able to do in academic subjects.

Example of a Standard:
The student uses numerical and computational concepts and procedures in a variety of situations.

Benchmark: A benchmark is a specific statement of what a student should know and be able to do at a specified time in his/her schooling. Benchmarks are used to measure a student's progress towards meeting the standard. Statements outlining the specifics of what a student should know and be able to do are found directly following the benchmark. For the purpose of this document, benchmarks are defined for grades, 2, 4, 7, and 10, which coincides with the Kansas Mathematics Assessments being given at grades 4, 7, and 10.

Example of a Grade Level Benchmark:
Seventh Grade: The student demonstrates an understanding of the rational number system and pi, recognizes, applies, and explains its properties, and extends these properties to algebraic expressions in one variable.

Indicator: An indicator is a statement of the knowledge or skills which a student demonstrates in order to meet the benchmark. Indicators are critical to understanding the standards and benchmarks and are intended to be met by all students. The set of indicators listed under each benchmark is not listed in priority order, nor should the list be considered as all inclusive. There are two types of indicators - knowledge base indicators and application indicators. The Kansas Assessments will be composed of items which are designed to assess a student's ability to meet each of these two types of indicators. Indicators in the objective item pool for the Kansas Assessments are marked. The remaining indicators are recommendations for school districts to include in their local curriculum but will not be assessed on the Kansas Mathematics Assessments at this time.

Example of an Indicator:
Fourth Grade: The student states and uses multiplication and corresponding division facts for numbers up to twelve times twelve with efficiency and accuracy.

Clarifying Example: A clarifying example is an illustration of the meaning or intent of the indicator. Examples provide a clearer understanding of both the indicator and the benchmark but are not meant to be inclusive. In this document clarifying examples can be found at the end of an indicator after the words "such as".

Clarifying Example for the Fourth Grade Indicator listed above: "such as 6 x 9".

Possible Grade Level Indicator: A possible grade level indicator is an indicator which has been developed for a grade level which is not one of the benchmark levels. To assist schools in developing their local curriculum, instruction and assessments, the State Board directed the committee to develop possible indicators for kindergarten, first grade, third grade, fifth grade, sixth grade and eighth grade. These additional indicators for non-benchmarked grade levels represent one of several ways in which mathematics curriculum, instruction, and assessment could be organized at various non-benchmark grade levels to help students reach the second, fourth, seventh, and tenth grade benchmarks.

Example of a Possible Third Grade Indicator: The student states and uses multiplication facts up through the five's plus the ten's as well as the corresponding division facts with efficiency and accuracy.

Knowledge Base Indicators: The mathematical knowledge base indicators are a set of mathematical facts, concepts, and/or procedures which a student should know and/or be able to do. This knowledge base includes the basic computation facts within all of the various number systems. It includes the ability to perform mathematical procedures such as two-digit multiplication or determining the mean (average) of a data set, as well as being able to identify and explain mathematical concepts such as "What is a triangle?" or "What do we mean when we say multiply these two numbers?" Assessment questions which ask students to give a definition, explain a mathematical concept, or perform a procedure are considered knowledge base questions. Questions which measure the mathematical knowledge base can be presented in a variety of formats including word problems.

Application Indicators: The mathematical application indicators are statements which describe how the mathematical knowledge base should be used or applied to a real-world situation. These indicators ask a student to:

1) translate between the concrete, pictorial, graphical, symbolic, verbal or mental representations of mathematical facts, concepts or procedures such as one-half could be represented by .5, 50%, a set of two out of four objects, or a picture of a pie which has 1/2 of the pie shaded; or the same line could be represented by graph, three or more ordered pairs, or various forms of the equation of a line.
2) make inferences by using deductive, inductive, proportional or spatial reasoning such as generalizing a pattern, formulating examples or counterexamples such as "Can the product of two odd numbers ever be even? Why or Why not?" or determining if results are reasonable such as "Is it reasonable to say that one thousand sticks of new chewing gum could fit into a box which is three inches by four inches by five inches?".
3) generate problems such as "Shawn had three pair of blue jeans and five T-shirts. What are some mathematical problems which could be asked?" or "A room has dimensions of 10 yards by 5 yards. New carpet costs $6.95 a square foot plus $1.00 per square foot for installation. What mathematical questions could be asked?"
4) apply mathematical facts, concepts, or procedures in order to solve problems generated from situations which the student may or may not have seen before. Questions or activities which have a problem-solving focus ask the student to perform one or more of the following skills:
    a) find one or more reasonable and plausible solutions to a given problem situation.
    b) demonstrate the understanding of the problem by restating the problem in his/her own words, identifying information which is known, explaining the mathematical language used in the problem, and/or identifying additional conditions or restrictions not given in the original statement of the problem.
    c) identify, discuss, and choose one or more strategies which can be implemented in order to find a solution to a given problem situation.
    d) implement one or more strategies which has (have) been identified as a way to find a solution to a given problem situation.
    e) review and revise the original problem identification, strategy selection, strategy implementation, and/or report the solution to a problem situation if the reported solution does not seem reasonable.
    f) explain the advantages and disadvantages of various strategies which could be used to provide a solution to a problem situation.
    g) explain the advantages and disadvantages of various solutions to a problem situation.
    h) recognize or explain a process which was used to solve a problem situation.

Application problems sometimes call for the student to make choices about the knowledge base which the student will use to make an inference or solve a problem. Application problems often allow the student to have some flexibility in the algorithm(s) which is(are) used. In many cases problems which emphasize reasoning or problem solving can be classified as application problems. See Appendix 1 for a more detailed description of strong reasoning and problem solving skills. Questions which measure mathematical application can be presented in a variety of formats.

Uses of this Document

Development of Local Curriculum and Assessments

As was previously stated, this document has been designed to serve two purposes: 1) to assist Kansas educators in developing local curricula and assessments, and 2) to develop state assessments in mathematics. When this document is used in the process of developing local curricula and assessments, the reader will want to consider which of the indicators and benchmarks should be considered to be included in their local curriculum, regardless of how the indicator is prioritized for inclusion on the Kansas Assessments. It is not expected that all districts will develop curriculum to include every indicator; instead the document has been developed to provide information to assist a broad range of different local curricular emphases.

For example, if a local building or district would like to emphasize the area of statistics over geometry at the middle school level, educators may want to include several of the statistics indicators which will not be assessed on the state assessment in their middle school curriculum and local assessments, but none of the additional geometry indicators, or additional mathematics knowledge and skills which are listed in this document. Another district may want to design its curriculum to emphasize number sense and computation.

Even though benchmarks and indicators have been designated "by the end of" a specific grade, it is NOT the committee's intent that the curriculum, instruction and assessments to help students meet the benchmark always be limited to the specified grade level. For example "by the end of the fourth grade" does not necessarily mean that this topic should only be taught at fourth grade. Some districts may want to divide indicators among one or more grade levels and then reinforce the topic at the next grade level. Still other districts may want to delay the introduction of indicators which will not be on the state assessment until the year or years following the specified grade level. To assist schools in organizing their local curriculum, instruction, and assessments, the State Board directed the committee to develop possible indicators for kindergarten, first grade, third grade, fifth grade, sixth grade, and eighth grade. These additional indicators represent one of several ways in which mathematics curriculum, instruction, and assessment could be organized in grades K - 8, and tenth grade to help students reach the fourth, seventh, and tenth grade benchmarks. A local decision will need to be made on how curriculum, instruction and assessment will be organized throughout all grade levels to help students meet these expectations.

For districts developing middle school or high school curriculum by specific courses rather than by grade level, decisions will need to be made regarding which indicators will be emphasized in which courses. Districts should keep in mind that all students will be assessed on those indicators marked for inclusion on the Kansas Mathematics Assessments regardless of course enrollment. It is the intention of this document that all students taking regular education courses at the high school level have access to all of the indicators marked for assessment listed regardless of the course(s) in which they are enrolled.

> ***Special Technology Note**: Because technology impacts the mathematics a student will need to learn, it is important that this document incorporates the use of technology into some of the standards, benchmarks, and indicators. However the use of technology, such as calculators and computer graphing utilities does not replace the need for students to be able to perform computations or other procedures using mental mathematics or paper and pencil.*

Development of the Kansas Mathematics Assessments

1. **Grade Levels to Be Assessed** - The writing committee recommended to the State Board that the Kansas Assessments continue to be administered at their current grade levels (fourth, seventh, and tenth grade). The State Board acted upon this request at their May 1998, meeting and accepted this recommendation.

2. **Kansas Assessment Scores to be Reported** - The writing committee recommended a change in the assessment scores to be reported. Since 1995, the Kansas Assessment reported subscale scores in problem solving, reasoning, communication and a total score called the power score. In order to

accurately reflect the content emphasis in the revised standards, benchmarks and indicators, the writing committee recommended the following scores be reported at the individual, building, district, and state level:

1) a knowledge base subscale score;
2) an application subscale score; and
3) a total score derived from the two subscale scores.

The State Board acted on this request at their May 1998 meeting and accepted the committee's recommendation for scores to be reported.

> *Special Note: It is recommended that schools using the previous Kansas Mathematics Assessments subscale scores of reasoning or problem solving as a measure of a targeted area within their school improvement plan now use the application subscale score as a new baseline measure for reasoning or problem solving.*

Definition of Knowledge Base Indicators for Kansas Mathematics Assessment Purposes: The mathematical knowledge base is a set of mathematical facts, concepts, and/or procedures which a student should know and/or be able to do. This knowledge base includes the basic computation facts within all of the various number systems. It includes the ability to perform mathematical procedures such as two-digit multiplication or determining the mean (average) of a data set, as well as being able to identify and explain mathematical concepts such as "What is a triangle?" or "What do we mean when we say multiply these two numbers?" Assessment questions which ask students to give a definition, explain a mathematical concept, or perform a procedure are considered knowledge base questions. Questions which measure the mathematical knowledge base can be presented in a variety of formats including word problems.

Definition of Application Indicators for Kansas Mathematics Assessment Purposes: The mathematical application indicators are statements which describe how the mathematical knowledge base should be used or applied to a real-world situation. These indicators ask a student to:

1) translate between the concrete, pictorial, graphical symbolic, verbal or mental representations of mathematical facts, concepts or procedures such as one-half could be represented by .5, 50%, a set of two out of four objects, or a picture of a pie which has 1/2 of the pie shaded; or the same line could be represented by graph, three or more ordered pairs, or various forms of the equation of a line.
2) make inferences by using deductive, inductive, proportional or spatial reasoning such as generalizing a pattern, formulating examples or counterexamples such as "Can the product of two odd numbers ever be even? Why or Why Not?" or determining if results are reasonable such as "Is it reasonable to say that one thousand sticks of new chewing gum could fit into a box which is three inches by four inches by five inches?".
3) generate problems such as "Shawn had three pair of blue jeans and five T-shirts, what are some mathematical problems which could be asked?" or "A room has dimensions of 10 yards by 5 yards. New carpet costs $6.95 a square foot plus $1.00 per square foot for installation. What mathematical questions could be asked?"
4) apply mathematical facts, concepts, or procedures in order to solve problems generated from situations which the student may or may not have seen before. For the purpose of the Kansas Assessment, items asking students to solve real-world problems will ask the student to use one or more of the following skills:
    a) find one or more reasonable and plausible solutions to a given problem situation.
    b) demonstrate the understanding of the problem by restating the problem in his/her own words, identifying information which is known, explaining the mathematical language used in the problem, and/or identifying additional conditions or restrictions not given in the original statement of the problem.
    c) identify, discuss, and choose one or more strategies which can be implemented in order to find a solution to a given problem situation.
    d) implement one or more strategies which has (have) been identified as a way to find a solution to a given problem situation.

e) review and revise the original problem identification, strategy selection, strategy implementation, and/or report the solution to a problem situation if the reported solution does not seem reasonable.

Application problems often call for the student to make choices about the knowledge base which will be used to make an inference or solve a problem. Application problems often allow the student to have some flexibility in the algorithm(s) which are used. In many cases problems which emphasize reasoning or problem solving can be classified as application problems. See Appendix 1 for a more detailed description of strong reasoning and problem solving skills. Questions which measure mathematical application can be presented in a variety of formats.

3. **The Use of Calculators on Kansas Mathematics Assessments** - *Students will **not** be allowed to use calculators, abacuses or computers on any portion of the fourth grade assessment. At seventh and tenth grade there will be a **non-calculator** section where students will **not** be able to use calculators, abacuses, computers or other computational devices.* Indicators which will be assessed on the Kansas Assessment without the student using a calculator are marked with an "N". On all other portions of the assessment the use of calculators will be allowed, although these items will be classified as "calculator-neutral." Calculator neutral means assessment items are not dependent upon the use of a calculator and therefore could be completed without using a calculator. A detailed list of the computations which will be included on the non-calculator sections of the assessments can be found under Standard 1, Benchmark 4 at each of the respective grade levels assessed. The types of calculators which could be used on the state assessment are the types of calculators which are normally used in classroom instruction by grade level. In most schools across the state a scientific or graphing calculator is used in grades seven and ten. The use of computers or abacuses is not allowed at any grade level on the mathematics assessments.

4. **Prioritization of Indicators to be Assessed** - One of the charges to the committee by the State Board of Education was to prioritize the Standards which are to be included for the Kansas Mathematics Assessments beginning in the Spring of 2000. Indicators which will be assessed on the Kansas Mathematics Assessments are marked with a "Δ". Indicators which will be assessed on the Kansas Mathematics Assessments without the student using a calculator are marked with an "N".

Each of the indicators recommended by the Standards Writing Committee to be assessed on the new Kansas Mathematics Assessments met two or more of the following criteria:

1. The indicator is important enough to be assessed at the state level. It reflects high but reasonable expectations which could result in driving important curriculum and instructional change.

2. The indicator contains important knowledge and skills which every student should know and be able to do, even if it is not currently in local mathematics curriculum or textbooks.

3. The indicator contains important mathematical knowledge and skills which a student needs to solve problems encountered in the real world.

4. The indicator contains knowledge and skills which are necessary to be successful at a higher level of mathematics. The higher level of mathematics may or may not be included on the state assessment at a higher grade level.

5. The indicator contains knowledge or skills which have pre-requisite skills at the same or an earlier grade level.

In addition the committee made sure that at least one indicator from each of the four standards was included at every grade level assessed and that at some point within the fourth, seventh or tenth grade assessments each benchmark was assessed.

Since the document is meant to assist in local curriculum development as well as specify what will be assessed on the state assessment, some indicators have a clarifying statement. These statements bring additional clarity and specificity to the mathematical content and skills which the student should be able to use for assessing the indicator on the Kansas Mathematics Assessments. For example, a fourth grade indicator on computation states: "The student explains and performs computational procedures involving whole numbers, proper fractions with like denominators and money." Fourth grade students can be working on a variety of computational skills relating to this indicator, but on the Fourth Grade Kansas Mathematics Assessment a student will be asked to perform a specific set of computational skills without the aid of a calculator. The specific skills are listed below the computation indicator after the statement "*For the purpose of assessing this indicator on the Kansas Mathematics Assessments the student should be able to:*".

The indicators marked for inclusion on the Kansas Mathematics Assessments do reflect some changes from what has been assessed prior to the 1999-2000 school year. By assessing knowledge base and application rather than the subscales of problem solving, reasoning, and communication, the new assessments will provide more balance in the assessment of mathematical content knowledge and application. For example, there will be an increased emphasis on computational skills at the fourth grade and seventh grade and a decreased emphasis in probability at all grade levels. Although the mathematical content within the standards, benchmarks and indicators is at a very high level, several of the high school mathematical knowledge base indicators marked for assessment may not be as rigorous as what is currently assessed. This is counter-balanced by the fact that students will be assessed on their ability to apply their knowledge base at a more rigorous level within a real-world context. (i.e. The assessment aims at depth rather than breadth.)

Special Notes:

1) Since the committee is not recommending a Kansas Assessment be given at grade levels other than fourth, seventh, and tenth grade, indicators for grades kindergarten through third, fifth, sixth, and eighth have not been prioritized for assessment.

2) If the state assessment contractor determines there are indicators which have been recommended to be included in the development of objective items for the Kansas Assessment, and those indicators cannot be assessed using an objective item format, they will be reprioritized.

Supplemental Documents

The committee has discussed the need for supplemental documents. These documents would be used to illustrate how benchmarks can be supported at grade levels or in courses at the high school level and could include examples of classroom activities and assessments which are aligned with the Standards. Supplemental materials will be developed on an ongoing basis. As these documents are developed, they will be posted at **www.ksbe.state.ks.us** which is the website of the Kansas State Department of Education.

The Mathematics Curriculum Standards

Standard 1: NUMBER AND COMPUTATION - The student uses numerical and computational concepts and procedures in a variety of situations.

Standard 2: ALGEBRA - The student uses algebraic concepts and procedures in a variety of situations.

Standard 3: GEOMETRY - The student uses geometric concepts and procedures in a variety of situations.

Standard 4: DATA - The student uses concepts and procedures of data analysis in a variety of situations.

A One Word or Phrase Summary of the Mathematics Standards and Corresponding Benchmarks

(Standards appear in bold type and benchmarks in regular type.)

1. **Number and Computation**
   Number Sense
   Number Systems and Their Properties
   Estimation
   Computation

2. **Algebra**
   Patterns
   Variables, Equations, and Inequalities
   Functions
   Models

3. **Geometry**
   Geometric Figures and Their Properties
   Measurement and Estimation
   Transformational Geometry
   Geometry from an Algebraic Perspective

4. **Data**
   Probability
   Statistics

Indicators crucial to understanding the standards and benchmarks have been developed by grade levels and can be found on the following pages. The indicators are not listed in priority order nor should the list be considered as all inclusive.

Kansas

Curricular Standards for Mathematics

by

Grade Level

Standard 1: The student uses numerical and computational concepts and procedures in a variety of situations.

Benchmark 1: NUMBER SENSE - The student demonstrates number sense for three-digit whole numbers and simple fractions in a variety of situations.

Second Grade Knowledge Base Indicators

The student:

1. compares and orders whole numbers to 1,000 and simple fractions (fourths, thirds, and halves) using concrete materials.
2. knows, explains, and represents whole numbers to 1,000.
3. uses addition and subtraction facts to show equivalent representations for whole numbers such as 8-5=2+1 or 20+40=70-10.
4. identifies coins, states their values, and determines the total value (to $1.00) of a mixed group of coins using pennies, nickels, dimes, quarters, or half-dollars.
5. counts like combinations of the following bills: $1, $5, $10, and $20.
6. identifies and uses ordinal positions.

Second Grade Application Indicators

The student:

1. uses appropriate representations of whole numbers to formulate and solve real-world problems.
2. determines reasonableness of numerical values involving whole numbers to 1,000, simple fractions, and money using decimals up to hundredths.

Possible First Grade Knowledge Base Indicators

The student:

1. compares and orders whole numbers up to 100 and fourths and halves with concrete materials.
2. knows, explains, and represents whole numbers to 100 using concrete materials.
3. identifies and states the value of the following coins: pennies, nickels, dimes, and quarters; and the following bills: $1, $5, $10, and $20.
4. recognizes and counts a like group of coins consisting of pennies, nickels, and dimes.
5. identifies and uses ordinal positions up to tenth.
6. uses pictures or models to recognize and represent equal parts of a whole.

Possible First Grade Application Indicators

The student:

1. uses appropriate representations of whole numbers to formulate and solve real-world problems.
2. determines reasonableness of numerical results involving whole numbers to 100.

Possible Kindergarten Knowledge Base Indicators

The student:

1. compares and orders whole numbers to 20.
2. recognizes a whole, half, and parts of a whole.
3. establishes a one-to-one correspondence to 20 items and identifies, states or writes the appropriate cardinal number.
4. identifies and states the values of pennies and dimes.
5. identifies positions as first and last.

Possible Kindergarten Application Indicators

The student:

1. uses numbers and concrete items to twenty to formulate and solve real-world problems.

Δ This indicator will be assessed at the state level.
N The use of calculators, abacuses or computers will not be allowed during the assessment of this indicator at the state level.
Indicators are not listed in priority order, nor are they considered as all inclusive.

Benchmark 2: NUMBER SYSTEMS AND THEIR PROPERTIES - The student demonstrates an understanding of simple fractions (fourths, thirds, halves) and three-digit whole numbers with a special emphasis on place value, and recognizes, applies, and explains their properties.

Second Grade Knowledge Base Indicators

The student:

1. identifies the place value of various digits in whole numbers to 1,000.
2. counts subsets of numbers from 1 to 1,000 forwards and backwards such as 311, 312. 313,..., 317; 210, 209, 208, ..., 204.
3. reads or writes whole numbers to 1,000 in numeric form and whole numbers from zero to 100 in words, such as 76 can be written as seventy-six.
4. uses concepts of the following whole number properties and demonstrates their meaning with concrete materials:
   a) the commutative property of addition such as 3+2=2+3.
   b) the associative property of addition such as (3+2)+4=3+(2+4).
   c) the additive identity property (zero property of addition) such as 4+0=4.
   d) the symmetric property applied to basic addition and subtraction facts such as 10=2+8 is the same as 2+8=10 or 7=10-3 is the same as 10-3=7.
5. identifies odd and even whole numbers to 100.

Second Grade Application Indicators

The student:

1. uses properties of the whole number system and money to explain reasoning, and to formulate and solve real-world problems.
2. uses whole number properties to perform various computational procedures.

Possible First Grade Knowledge Base Indicators

The student:

1. identifies the place value of various digits in whole numbers to 100.
2. counts subsets of numbers from 1 to 100 both forwards and backwards.
3. reads and writes whole numbers to 100 in numeric form and whole numbers from zero to ten in words.
4. identifies odd and even whole numbers to 50.

Possible First Grade Application Indicators

The student:

1. uses properties of the whole number system and money to explain reasoning, and to formulate and solve real-world problems.
2. uses whole number properties to perform various computational procedures.

Possible Kindergarten Knowledge Base Indicators

The student:

1. groups objects into tens.
2. counts subsets of numbers from 1 to 20.
3. counts backwards from 10.
4. reads and writes whole numbers to 20 in numeric form.

Possible Kindergarten Application Indicators

The student:

1. uses properties of the whole number system and money to explain reasoning, and to formulate and solve real-world problems.
2. uses whole number properties to perform various computational procedures.

20

Δ This indicator will be assessed at the state level.
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Indicators are not listed in priority order, nor are they considered as all inclusive.

Benchmark 3: ESTIMATION - The student uses numerical estimation with whole numbers up to 999, simple fractions, and money.

Second Grade Knowledge Base Indicators

The student:

1. uses a variety of computational methods including mental mathematics, paper and pencil, concrete materials, and technological tools such as calculators and computers to estimate quantities involving whole numbers, simple fractions, and money.
2. uses various estimation techniques, including front-end with adjustment for two digit numbers, and rounding to the nearest ten, with whole numbers to 1000.

Second Grade Application Indicators

The student:

1. uses estimation to check reasonableness of results and make predictions in situations involving whole numbers, simple fractions and money.
2. adjusts original whole number estimates based on additional information (estimation from a frame of reference).

Possible First Grade Knowledge Base Indicators

The student:

1. uses concrete objects to make estimates based on a frame of reference with numbers to 100.
2. uses estimation to check reasonableness of results of numbers to 100.

Possible First Grade Application Indicators

The student:

1. adjusts whole number estimates based on additional information (estimation from a frame of reference).
2. selects a reasonable magnitude from three given quantities, a one-digit numeral, a two-digit numeral, and a three-digit numeral (5, 50, 500), and explains the reasonableness of his/her choice for a familiar problem situation involving magnitude.

Possible Kindergarten Knowledge Base Indicators

The student:

1. determines if one set of objects has more, less or about the same number of objects as a second set of the same kind of objects.

Possible Kindergarten Application Indicators

Benchmark 4: COMPUTATION - The student explains, models and performs computation with two-digit whole numbers in a variety of situations.

Second Grade Knowledge Base Indicators

The student:

1. uses a variety of computational methods including mental arithmetic (doubles and neighbors), paper and pencil, concrete materials, and technological tools such as calculators and computers.
2. states and uses whole number addition facts with sums to 20 or less and corresponding subtraction facts with efficiency and accuracy.
3. explains and performs addition and subtraction on amounts of money to 99¢ using cent notation (25¢ + 52¢) and concrete materials.

Second Grade Application Indicators

The student:

1. selects and uses addition and subtraction procedures to formulate and solve real-world problems involving whole numbers and money.

Δ This indicator will be assessed at the state level.
N The use of calculators, abacuses or computers will not be allowed during the assessment of this indicator at the state level.
Indicators are not listed in priority order, nor are they considered as all inclusive.

4. explains and performs addition and subtraction with two-digit whole numbers with and without regrouping.
5. skip counts by two's, five's, or ten's to 100 and three's to 36.
6. identifies addition and subtraction fact families.
7. knows different ways to read and write the same subtraction expression such as 6-3 is the same as 6
   -3.

Possible First Grade Knowledge Base Indicators

The student:

1. uses a variety of computational methods including mental arithmetic (doubles and neighbors), paper and pencil, concrete materials, and technological tools such as calculators and computers.
2. states and uses basic addition facts with sums to 10 or less and their corresponding subtraction facts with efficiency and accuracy.
3. explains and performs addition and corresponding subtraction with sums to 100 using concrete objects for regrouping.
4. explains and performs addition and subtraction without regrouping to sums of 100.
5. skip counts by two's, five's, and ten's to 50.
6. uses concrete materials to show addition and subtraction are opposite operations.
7. knows different ways to read and write the same addition expression, such as: 5+4 is the same as 5
   +4.

Possible First Grade Application Indicators

The student:

1. selects and uses addition and subtraction to formulate and solve real-world problems involving selected whole numbers.

Possible Kindergarten Knowledge Base Indicators

The student:

1. performs addition and subtraction using up to 10 concrete items.

Possible Kindergarten Grade Application Indicators

The student:

1. uses addition and subtraction to formulate and solve real-world problems involving up to ten items.

22

Δ This indicator will be assessed at the state level.
N The use of calculators, abacuses or computers will not be allowed during the assessment of this indicator at the state level.
Indicators are not listed in priority order, nor are they considered as all inclusive.

Standard 2: The student uses algebraic concepts and procedures in a variety of situations.

Benchmark 1: PATTERNS - The student recognizes, describes, extends, develops, and explains relationships in patterns from a variety of situations.

Second Grade Knowledge Base Indicators

Using concrete materials, drawings, or other representations, the student:

1. identifies and continues patterns presented in a variety of formats: numeric, visual, oral, written, kinesthetic, pictorial, tabular, graphical, or listing.
2. creates a pattern.

A partial list of patterns to help students meet these indicators could include:

- whole number patterns such as 11, 22, 33 ... or 2, 4, 6.
- measurement and geometric patterns.
- calendar patterns.
- money and time patterns such as 1:45, 1:30, 1:15... or $5, $10, $15 ...
- patterns occurring in nature such as seasons, temperature, or weather.
- number theory patterns such as odds, evens, and skip counting by 3's and 4's.
- simple kinesthetic patterns such as snapping fingers, clapping, or stomping feet.
- visual patterns including shape or color.

Special Note: Working with various types of patterns is an important precursor to working with functions and sequences in middle school and high school.

Second Grade Application Indicators

The student:

1. generalizes a pattern using a written description.
2. recognizes the same general pattern presented in different representations such as recognizing red, yellow, red, yellow, red, yellow . . . and 1,2,1,2,1,2 . . . are both examples of ab patterns.

Possible First Grade Knowledge Base Indicators

Using concrete materials, drawings, or other representations, the student:

1. identifies and continues patterns presented in a variety of formats: numeric, visual, oral, kinesthetic, pictorial, tabular, graphical, or listing.
2. creates a pattern.

A partial list of patterns to help students meet these indicators could include:

- whole number patterns such as 1, 2, 3, 1, 2, 3...
- geometric patterns by two attributes.
- money patterns such as 1¢, 2¢, 3¢, ... or 10¢, 20¢, 30¢, ...

Possible First Grade Application Indicators

The student:

1. generalizes patterns by giving oral descriptions.
2. recognizes the same general pattern presented in different representations such as recognizing red, yellow, red, yellow, red, yellow . . . and 1,2,1,2,1,2 . . . are both examples of ab patterns.

Δ This indicator will be assessed at the state level.
N The use of calculators, abacuses or computers will not be allowed during the assessment of this indicator at the state level.
Indicators are not listed in priority order, nor are they considered as all inclusive.

patterns occurring in seasons and daily life such as winter, spring, summer, fall.
skip counting by 2's, 5's, and 10's.
simple kinesthetic patterns such as snapping fingers, clapping or stomping feet.
visual patterns in shape and color by large triangle, small triangle, large triangle, ... or red circle, blue circle, red circle, blue circle, ...
identify, sort, and describe groups of objects by attributes such as these dogs have spots, those do not.
identifies objects which do not belong to a particular group.

Special Note: Working with various types of patterns is an important precursor to working with functions and sequences in middle school and high school.

Possible Kindergarten Knowledge Base Indicators

The student:

1. identifies and continues patterns presented in a variety of formats: numeric, visual, oral, kinesthetic, pictorial, tabular, graphical, or listing.
2. creates a pattern.

A partial list of patterns to help students meet these indicators could include:
geometric patterns by 1 attribute.
daily life patterns such as grass is green, sky is blue.
identify and sort objects by similar traits.

Special Note: Working with various types of patterns is an important precursor to working with functions and sequences in middle school and high school.

Possible Kindergarten Application Indicators

The student:

1. generalizes patterns by giving oral descriptions.
2. recognizes the same general pattern presented in different representations such as recognizing red, yellow, red, yellow, red, yellow . . . and 1,2,1,2,1,2 . . . are both examples of ab patterns.

Benchmark 2: VARIABLES, EQUATIONS, AND INEQUALITIES - The student uses symbols and whole numbers up to 99 to solve addition and subtraction equations in a variety of situations.

Second Grade Knowledge Base Indicators

The student:

1. explains or uses symbols for whole number unknown quantities.
2. solves equations involving addition or subtraction in order to find the sum or difference such as 32+19=Δ or 79-46=Δ.
3. finds missing addends and subtrahends using

Second Grade Application Indicators

The student:

1. uses symbols to represent problem situations which involve unknown quantities.
2. formulates and solves problem situations involving addition and subtraction.

24

Δ This indicator will be assessed at the state level.
N The use of calculators, abacuses or computers will not be allowed during the assessment of this indicator at the state level.
Indicators are not listed in priority order, nor are they considered as all inclusive.

basic addition and subtraction facts such as 7+ Δ=12 or 12-Δ=7.

4. solves money equations involving up to two different coins such as nickel + penny = Δ ¢.
5. compares two whole numbers between 0 and 1,000 using symbols (<, >, or =) and words such as less than, greater than, or equal to.

Possible First Grade Knowledge Base Indicators

The student:

1. explains or uses symbols for whole number unknown quantities.
2. solves equations involving addition and subtraction in order to find the sums or differences such as 2+Δ = 9.
3. orally explains and compares two whole numbers between 0 and 100 using vocabulary less than, greater than, or equal to 100.

Possible First Grade Application Indicators

The student:

1. uses concrete items, symbols, pictures or oral descriptions to represent problem situations which involve unknown quantities.
2. formulates and solves problem situations with missing sums or differences.

Possible Kindergarten Knowledge Base Indicators

The student:

1. uses concrete materials to find missing number facts to sums of ten.

Possible Kindergarten Application Indicators.

The student:

1. describes mathematical situations orally or by using concrete items and pictures.

Benchmark 3: FUNCTIONS - The student recognizes and describes relationships between whole numbers through 99 in a variety situations.

Second Grade Knowledge Base Indicators

The student:

1. uses a variety of methods to recognize relationships including mental mathematics, paper and pencil, and concrete materials.
2. generalizes simple numeric patterns by stating the rule using symbol notation such as for 2, 4, 6, 8, 10 . . .; the rule is □ + 2 each time.
3. uses numbers and symbols to describe whole number addition and subtraction relationships. 3+2=5, □ +2=5.
4. graphs ordered pairs on a given grid in the first quadrant.
5. finds values or determines the rule from input/out machines, T-tables or function tables which involve addition or subtraction of whole numbers.

Second Grade Application Indicators

The student:

1. uses concrete items, symbols, oral descriptions or pictures to represent and describe mathematical relationships.
2. recognizes and extends numerical patterns.

Possible First Grade Knowledge Base Indicators

The student:

1. uses a variety of methods to recognize relationships including mental mathematics, paper and pencil, and concrete materials.
2. records numerical relations in tables.
3. plots numbers up to 100 on a number line.

Possible First Grade Application Indicators

The student:

1. uses concrete items, symbols, pictures or oral descriptions to represent and describe mathematical relationships.
2. recognizes numerical patterns.

25

Δ This indicator will be assessed at the state level.
N The use of calculators, abacuses or computers will not be allowed during the assessment of this indicator at the state level.
Indicators are not listed in priority order, nor are they considered as all inclusive.

Possible Kindergarten Knowledge Base Indicators

The student:

1. locates numbers up to 20 on a number line.

Possible Kindergarten Application Indicators

The student:

1. uses concrete items, pictures and oral descriptions to represent and describe relationships.

Benchmark 4: MODELS - The student develops and uses models to represent and show mathematical relationships found in a variety of situations.

Second Grade Knowledge Base Indicators

The student:

1. uses mathematical models to represent and explain mathematical concepts and procedures.
2. uses concrete objects, diagrams, pictures and dramatizations to show the relationship between two or more things.

The student knows, explains, and uses mathematical models such as:

graphs and tables using real objects, representational objects or abstract representations to display data.

place value models such as place value mats, hundreds charts, and base ten blocks.

process models for whole number operations such as pictures or objects representing addition and subtraction, the number line, or the hundreds chart.

Venn Diagrams to sort data using two attributes.

T-tables to find relationships between numbers.

diagrams and pictures to model situations.

Second Grade Application Indicators

The student:

1. recognizes the same situation can be represented in more than one way such as using base-ten blocks, the number line or properties of whole numbers to explain a procedure for the addition of two whole numbers.

Special Note: The mathematical modeling process involves:

a) selecting key features and relationships within the real world situation and representing these concepts in mathematical terms through some sort of mathematical model;

b) performing manipulations and mathematical procedures within the mathematical model;

c) interpreting the results of the manipulations within the mathematical model and using these results to make inferences about the original real-world situation.

Possible First Grade Knowledge Base Indicators

The student:

1. uses mathematical models to represent and explain mathematical concepts and procedures.
2. uses concrete objects, diagrams, pictures and dramatizations to show the relationship between two or more things.

The student knows, explains, and uses mathematical models such as:

graphs and tables using real objects, representational objects or abstract representations to display data.

place value models such as place value mats, hundreds charts, and base ten blocks.

process models for whole number operations

Possible First Grade Application Indicators

The student:

1. recognizes the same situation can be represented in more than one way.

Special Note: The mathematical modeling process involves:

a) selecting key features and relationships within the real world situation and representing these concepts in mathematical terms through some sort of mathematical model;

b) performing manipulations and mathematical procedures within the mathematical model;

c) interpreting the results of the

Δ This indicator will be assessed at the state level.
N The use of calculators, abacuses or computers will not be allowed during the assessment of this indicator at the state level.
Indicators are not listed in priority order, nor are they considered as all inclusive.

such as pictures or objects representing addition and subtraction, the number line, or the hundreds chart.
Venn Diagrams to sort data using two attributes.
diagrams and pictures to model situations.

Possible Kindergarten Knowledge Base Indicators

The student:

1. uses mathematical models to represent and explain mathematical concepts and procedures.
2. uses concrete objects, diagrams, pictures and dramatizations to show the relationship between two or more things.

The student knows, explains, and uses mathematical models such as:
graphs and tables using real objects or organize and display data.
concrete objects and pictures.

manipulations within the mathematical model and using these results to make inferences about the original real-world situation.

Possible Kindergarten Application Indicators

The student:

1. recognizes the same situation can be represented in more than one way.

Special Note: The mathematical modeling process involves:

a) selecting key features and relationships within the real world situation and representing these concepts in mathematical terms through some sort of mathematical model;
b) performing manipulations and mathematical procedures within the mathematical model;
c) interpreting the results of the manipulations within the mathematical model and using these results to make inferences about the original real-world situation.

Δ This indicator will be assessed at the state level.
N The use of calculators, abacuses or computers will not be allowed during the assessment of this indicator at the state level.
Indicators are not listed in priority order, nor are they considered as all inclusive.

Standard 3: The student uses geometric concepts and procedures in a variety of situations.

Benchmark 1: GEOMETRIC FIGURES AND THEIR PROPERTIES - The student recognizes and describes properties of simple geometric shapes.

Second Grade Knowledge Base Indicators

The student:

1. uses appropriate technology, manipulatives and drawings to recognize or investigate properties of geometric figures.
2. compares the following geometric figures: circle, square, rectangle, triangle, and ellipse (oval).
3. recognizes, draws, and describes the following geometric figures: circle, square, rectangle, triangle, and ellipse (oval).
4. recognizes the following figures from a basic pattern block set: square, triangle, rhombus, hexagon, parallelogram and trapezoid.
5. recognizes the following geometric solids: cubes, cylinders, cones, and spheres.

Second Grade Application Indicators

The student:

1. formulates and solves real-world problems by applying properties of geometric figures.
2. categorizes a composite figure into the shapes used to form it.
3. combines several geometric shapes to make a larger shape.

Possible First Grade Knowledge Base Indicators

The student:

1. uses appropriate technology, manipulatives and drawings to recognize and investigate properties of geometric figures.
2. recognizes and draws circle, square, rectangle, triangle and ellipse (oval).

Possible First Grade Application Indicators

The student:

1. categorizes a composite figure into the shapes used to form it.
2. combines several geometric shapes to make a larger shape.
3. recognizes shapes within a picture.
4. recognizes shapes that have symmetry.
5. sorts shapes by specific attributes

Possible Kindergarten Knowledge Base Indicators

The student:

1. recognizes a circle, square, triangle, ellipse (oval), and rectangle.
2. uses appropriate technology, manipulatives and drawings to recognize or investigate properties of geometric figures.

Possible Kindergarten Application Indicators

The student:

1. recognizes and names shapes within their environment.
2. sorts concrete objects by specific attributes

Benchmark 2: MEASUREMENT AND ESTIMATION - The student estimates and measures using standard and nonstandard units in a variety of situations with an emphasis on the use of concrete materials.

Second Grade Knowledge Base Indicators

The student:

1. measures length to the nearest inch, to the nearest centimeter, and nonstandard units of length to the nearest whole unit; volume to the nearest pint, cup, quart, gallon or liter; temperature to the nearest degree.

Second Grade Application Indicators

The student:

1. formulates and solves real-world problems by applying measurements and measurement formulas.
2. uses estimation to check reasonableness of measurements and calculations.

A This indicator will be assessed at the state level.
N The use of calculators, abacuses or computers will not be allowed during the assessment of this indicator at the state level.
Indicators are not listed in priority order, nor are they considered as all inclusive.

2. selects or uses measurement tools for length, volume, temperature, and weight, and units of measure appropriate for the given situation.
3. states the number of minutes in an hour.
4. reads and tells time to the nearest quarter-hour using analog and digital clocks.

3. adjusts original measurements based on additional information (estimation from a frame of reference).
4. uses a balance to compare the weights of more than two objects.

Possible First Grade Knowledge Base Indicators

The student:

1. measures using nonstandard units to the nearest whole unit for length and weight.
2. selects appropriate measuring tools for length, volume, temperature, and weight for a given situation.
3. states number of days in a week and months in a year.
4. uses appropriate vocabulary to compare measurement: taller, shorter (height), hotter, colder (temperature), shorter, longer (length), heavier, lighter (weight).
5. reads and tells time at the half-hour using analog and digital clocks.

Possible First Grade Application Indicators

The student:

1. orders objects by size.
2. locates and names objects which are about the same size as a given object.
3. uses a balance to compare the weights of two objects.

Possible Kindergarten Knowledge Base Indicators

The student:

1. uses appropriate vocabulary to compare two measurements: taller, shorter (height), hotter, colder (temperature), shorter, longer (length).
2. reads and tells time at the hour using analog and digital clocks.

Possible Kindergarten Application Indicators.

The student:

1. compares and orders objects by size.
2. locates and names objects which are about the same size as a given object.

Benchmark 3: TRANSFORMATIONAL GEOMETRY - The student recognizes and describes a single geometric transformation of simple shapes or objects in a variety of situations.

Second Grade Knowledge Base Indicators

The student:

1. recognizes when a simple shape has undergone one transformation (rotation/turn, reflection/flip, and translation/slide).
2. recognizes two- or three-dimensional objects as they would appear from near or far.

Second Grade Application Indicators

The student:

1. shows two simple shapes are congruent by physically fitting one shape on top of the other.
2. gives or follows directions to move objects from one location to another.

Possible First Grade Knowledge Base Indicators

The student:

1. uses common spatial sense language such as behind, above, below, under, beside and in front of to describe the relationship between two objects.
2. knows that changing an object's position or orientation does not change its shape.

Possible First Grade Application Indicators

The student:

1. shows two simple shapes are congruent by physically fitting one shape on top of the other.
2. gives or follows directions to move objects from one location to another.

Possible Kindergarten Knowledge Base Indicators

Possible Kindergarten Application Indicators

Δ This indicator will be assessed at the state level.
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Indicators are not listed in priority order, nor are they considered as all inclusive.

The student:
1. identifies two like shapes from a set of four.
2. uses common spatial sense language such as above and below.

The student:
1. shows two shapes are congruent by physically fitting one shape on top of the other.
2. gives or follows directions to move objects from one location to another.

Benchmark 4: GEOMETRY FROM AN ALGEBRAIC PERSPECTIVE - The student identifies one or more points on a simple coordinate system (number line or grid) in a variety of situations.

Second Grade Knowledge Base Indicators

The student:
1. uses the number line to represent the distance between two whole numbers.
2. uses a number line to model addition and subtraction.
3. places or locates whole numbers to 1,000 on a number line.

Second Grade Application Indicators

The student:
1. uses the number line to formulate and solve real-world problems.

Possible First Grade Knowledge Base Indicators

The student:
1. places or locates whole numbers to 100 on a number line.
2. uses the number line to model addition or for counting.

Possible First Grade Application Indicators

The student:
1. uses the number line to formulate and solve real-world problems.

Possible Kindergarten Knowledge Base Indicators

The student:
1. places whole numbers one through twenty on a number line.

Possible Kindergarten Application Indicators

The student:
1. uses the number line to formulate and solve real-world problems.

30

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Standard 4: The student uses concepts and procedures of data analysis in a variety of situations.

Benchmark 1: PROBABILITY - The student uses probability to make predictions and decisions in a variety of situations.

Second Grade Knowledge Base Indicators

The student:

1. lists some of the possible outcomes of a simple experiment.
2. recognizes and explains whether outcomes of a simple event are equally likely to occur.

Second Grade Application Indicators

The student:

1. conducts experiments and simulations involving a simple event, records the results in charts, tables or graphs, and uses the results to draw conclusions about the event.

Possible First Grade Knowledge Base Indicators

The student:

1. recognizes whether an outcome of a simple experiment is possible or impossible.

Possible First Grade Application Indicators

The student:

1. conducts experiments and simulations involving a simple event and tallies the results.

Possible Kindergarten Knowledge Base Indicators

The student:

1. investigates, recognizes, and explains why a simple experiment can have more than one outcome.

Possible Kindergarten Application Indicators

The student:

1. conducts experiments and simulations involving a simple event and tallies the results.

Benchmark 2: STATISTICS - The student collects, displays, and explains whole number and other data in a variety of situations.

Second Grade Knowledge Base Indicators

The student:

1. organizes, displays and reads, numerical (quantitative) and non-numerical (qualitative) data in a clear, organized and accurate manner including correct titles, labels, categories or whole number intervals (includes knowing the importance of using the same size pictures or intervals to ensure the information is conveyed accurately at a glance). Specific graphical displays of whole number, monetary unit, and categorical data include:
   - frequency tables using tally marks.
   - graphs using concrete materials.
   - bar graphs.
   - Venn diagrams and other pictorial displays.
2. knows, explains, and conducts sampling techniques (observations, polling, tallying, and interviews) for gathering data.
3. identifies the largest and smallest data value.
4. identifies the mode for a data set containing up to two-digit whole numbers or identifies the category which occurs most often.

Second Grade Application Indicators

The student:

1. describes the results of data investigations and answers questions which are posed.
2. recognizes appropriate conclusions generated from the data collected and begins to recognize inappropriate descriptions of the data set.
3. recognizes that the same data set can be displayed in a variety of formats (i.e. Different display formats for the same data set can look different, but still be the same data set).

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Possible First Grade Knowledge Base Indicators

The student:

1. displays and reads data in a clear and organized manner using correct titles. Specific graphical displays of whole numbers, monetary units, and categorical data include:
   - frequency tables using tally marks.
   - graphs using concrete materials.
   - bar graphs.
   - Venn diagrams or other pictorial displays.
   - pictographs with the symbol or picture representing only one.
2. conducts different sampling techniques (observations, polls, tally marks, and interviews).
3. determines the set with the most (mode) after sorting by an attribute.
4. sorts and records qualitative data (non-numerical, categorical) sets using one attribute.

Possible First Grade Application Indicators

The student:

1. describes the results of data investigations and orally answers questions which are posed, such as identifying more, less, fewer, greater than, or less than from the information on a bar graph or pictograph.
2. begins to determine categories from which data could be gathered, such as shoe size, height, color of eyes, etc.

Possible Kindergarten Knowledge Base Indicators

The student:

1. gathers data relating to familiar experiences by counting and tallying.
2. displays information using objects and pictorial graphs and tables. Specific graphical displays of whole number and categorical data include:
   - frequency tables using tally marks.
   - graphs using concrete materials.
   - pictographs (with symbol or picture representing only one).

Possible Kindergarten Application Indicators.

The student:

1. describes the results of data collection orally, such as six children have red shoes and ten children have black shoes.

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Standard 1: The student uses numerical and computational concepts and procedures in a variety of situations.

Benchmark 1: NUMBER SENSE - The student demonstrates number sense for whole numbers, simple fractions, money, and decimals in a variety of situations.

Fourth Grade Knowledge Base Indicators

The student:

1. compares and orders whole numbers to 1,000,000, simple fractions (halves, fourths, eighths, sixteenths, thirds, tenths, hundredths), mixed numbers and decimals to the thousandths place.

NΔ 2. knows, explains, and uses addition, subtraction, multiplication, and division and other equivalent representations for whole numbers, decimals, time, and money, and addition, subtraction, and pictorial representations for simple fractions such as 12÷2=4+2 or 7¢=$.07=7/100 of a dollar.

Fourth Grade Application Indicators

The student:

1. uses appropriate representations of whole numbers to formulate and solve real-world problems.

NΔ 2. determines reasonableness of numerical values involving whole numbers to 1,000,000, simple fractions, and decimals to the thousandths.

Possible Third Grade Knowledge Base Indicators

The student:

1. compares and orders whole numbers to 100,000 and fractions with like denominators involving sixteenths, twelfths, eighths, fourths, thirds, halves, tenths, and hundredths using concrete materials.
2. knows, explains, and uses addition, subtraction, and multiplication to show equivalent representations for whole numbers such as 3x2=4+2.
3. knows, explains, and represents whole numbers to 100,000; decimals to tenths and hundredths; simple fractions; money (making change, mixed coinage for any amount, and money exchanges).

Possible Third Grade Application Indicators

The student:

1. uses appropriate representations of whole numbers to formulate and solve real-world problems.
2. determines reasonableness of numerical values involving whole numbers, simple fractions, and decimals when used as monetary amounts.

Benchmark 2: NUMBER SYSTEMS AND THEIR PROPERTIES - The student demonstrates an understanding of whole numbers with a special emphasis on place value, recognizes, uses, and explains their properties, and extends these properties to simple fractions, mixed numbers, decimals and money.

Fourth Grade Knowledge Base Indicators

The student:

1. recognizes the need for whole numbers, simple fractions, mixed numbers, and decimals to thousandths.
2. classifies various types of numbers as whole numbers, mixed numbers, or fractions and decimals; identifies the place value of various

Fourth Grade Application Indicators

The student:

NΔ 1. uses place value and properties of the whole number system and money to explain his/her reasoning, and to formulate and solve real-world problems.
For the purpose of assessing this indicator on the Kansas Assessment the student should be

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digits from thousandths up to millions.

3. identifies, models, writes, and reads numbers using numerals, words, and expanded form from thousandths to millions such as four million sixty-two thousand two hundred eighty-four = 4,062,284 = 4x1,000,000 + 6x10,000 + 2x1,000 + 2x100 + 8x10 + 4x1.

NΔ 4. uses the concepts of the following whole number properties: commutative property of addition and multiplication; associative properties of addition and multiplication such as 4+(2+3)=(4+2)+3 or 2x(3x4)=(2x3)x4, additive and multiplicative identity properties (zero property of addition and multiplicative property of one); the distributive property; the symmetric property of addition and multiplication such as 100=20+80 is the same as 20+80=100; and the multiplicative property of zero with two factors such as 9x0=0 or 112x0=0.

5. identifies odd and even numbers.

Possible Third Grade Knowledge Base Indicators

The student:

1. recognizes the need for whole numbers, simple fractions, and decimals (tenths and hundredths).
2. classifies various types of numbers as whole numbers, mixed numbers, fractions, and decimals.
3. identifies the place value of various digits from hundredths to one-hundred thousands.
4. identifies, models, writes, and reads numbers using numerals, words, and expanded form from hundredths to one hundred thousands such as sixty-four thousand three hundred eighty = 64,380 = 6x10,000 + 4x1,000 + 3x100 + 8x10 + 0x1.
5. uses the concepts of the following whole number properties: commutative property of addition and multiplication; additive and multiplicative identity properties (zero property of addition and multiplicative property of one); the distributive property; the symmetric property of addition and multiplication such as 100=20+80 is the same as 20+80=100; and the multiplicative property of zero with two factors such as 9x0=0 or 112x0=0.
6. identifies odd and even whole numbers to 1000.

able to:

a) use place value from thousandths up to millions.

b) use concepts of the following whole number properties: commutative property of addition and multiplication; associative properties of addition and multiplication such as 4+(2+3)=(4+2)+3 or 2x(3x4)=(2x3)x4, additive and multiplicative identity properties (zero property of addition and multiplicative property of one); the distributive property; the symmetric property of addition and multiplication such as 100=20+80 is the same as 20+80=100; and the multiplicative property of zero with two factors such as 9x0=0 or 112x0=0.

2. uses place value and whole number properties to perform various computational procedures, extends these properties to simple fractions, mixed numbers and decimals and explains how the properties are used.

Possible Third Grade Application Indicators

The student:

1. uses properties of the whole number system and money to explain reasoning, and to formulate and solve real-world problems.
2. uses and explains whole number properties to perform various computational procedures.

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Benchmark 3: ESTIMATION - The student uses numerical estimation with whole numbers, simple fractions, decimals, and money in a variety of situations.

Fourth Grade Knowledge Base Indicators

The student:

1. uses a variety of computational methods including mental mathematics, paper and pencil, concrete materials, and technological tools such as calculators and computers to estimate quantities involving whole numbers, simple fractions (halves, thirds, fourths) decimals (.1, .01, .001) and money.
2. explains and uses various estimation techniques, such as: front-end with adjustment, rounding, special numbers, clustering, and compatible numbers to estimate quantities using whole numbers, decimals, money, and simple fractions (halves, thirds, fourths).
3. recognizes and explains the difference between exact and approximate values.

Fourth Grade Application Indicators

The student:

1. uses estimation to check reasonableness of results, and makes predictions in situations involving whole numbers, simple fractions (halves, thirds, fourths) decimals and money.
2. adjusts original whole number estimates based on additional information (estimation from a frame of reference).

NΔ 3. determines if a problem situation calls for an exact or approximate answer and performs the appropriate computation.
For the purpose of assessing this indicator on the Kansas Assessment the student should be able to use various estimation techniques such as front-end with adjustment, rounding, special numbers, clustering, and compatible numbers to estimate quantities. See Benchmark 4 for a further explanation of computation expectations.

Possible Third Grade Knowledge Base Indicators

The student:

1. uses a wide variety of computational methods including mental mathematics, paper and pencil, concrete materials, and technological tools such as calculators and computers to estimate quantities involving whole numbers, simple fractions (halves, thirds, and fourths), decimals (.1 or .01), and money.
2. explains and uses estimation techniques, including front-end with adjustment, and rounding to the nearest tens, hundreds, or thousand.
3. recognizes and explains the differences between exact and approximate values.

Possible Third Grade Application Indicators

The student:

1. uses estimation to check reasonableness of results, and makes predictions in situations involving whole numbers, fractions including mixed numbers, decimals and money.
2. adjusts original rational number estimates based on additional information (estimation from a frame of reference).
3. determines if a problem situation calls for an exact or approximate answer and performs the appropriate computation.
4. estimates monetary amounts needed to make purchases.

Benchmark 4: COMPUTATION - The student explains and performs computation with whole numbers, addition and subtraction of proper fractions with like denominators, and money in a variety of situations.

Fourth Grade Knowledge Base Indicators

The student:

1. uses a variety of computational methods including mental arithmetic (doubles and neighbors), paper and pencil, concrete materials, and technological tools such as

Fourth Grade Application Indicators

The student:

NΔ 1. uses computational procedures to formulate and solve real-world problems involving whole numbers, proper fractions and money.
For the purpose of assessing this indicator

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calculators and computers.

2. states and uses multiplication and corresponding division facts for numbers up to twelve times twelve with efficiency and accuracy.
3. selects, explains and uses appropriate whole number operations.

NΔ 4. explains and performs computational procedures involving whole numbers, proper fractions with like denominators and money.

For the purpose of assessing this indicator on the Kansas Assessment the student should be able to perform the following computations without the aid of calculators, abacuses, or computers:

whole number addition and subtraction.

whole number multiplication up to a three-digit whole number by a two-digit whole number.

whole number division using dividends with up to three digits and a one-digit divisor.

addition and subtraction of monetary amounts using dollar and cents notation such as $47.07 + $356.96.

multiplication of whole dollar money amounts by a one - or two-digit whole number such as $45x16.

multiplication of money by whole numbers less than ten such as $14.12 x 7.

make correct change.

Although not assessed on the Kansas Assessment, the student also explains and performs the following computations:

whole number division using dividends with up to three-digits and the multiples of ten up to 100 as divisors.

division of three-digit whole dollar amounts by a one-digit whole number such as $999÷9.

addition and subtraction of proper fractions with like denominators.

NΔ 5. knows different ways to read and write the same addition, subtraction, multiplication or division expression such as: 6•4 is the same as 6x4 and 6 or $\underline{x4}$,

10 divided by 2 is the same as 10÷2 or $\frac{10}{2}$.

6. uses concrete materials to show the relationship between whole number addition and multiplication, and between whole number multiplication and division.

on the Kansas Assessment the student should be able to perform the following computations without the aid of calculators, abacuses, or computers:

whole number addition and subtraction.

whole number multiplication up to a three-digit whole number by a two-digit whole number.

whole number division using dividends with up to three digits and a one-digit divisor.

addition and subtraction of monetary amounts using dollar and cents notation such as $47.07 + $356.96.

multiplication of whole dollar money amounts by a one - or two-digit whole number such as $45x16.

multiplication of money by whole numbers less than ten such as $14.12 x 7.

make correct change.

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7. finds multiples of whole numbers.

Possible Third Grade Knowledge Base Indicators

The student:

1. uses a wide variety of computational methods including mental arithmetic (doubles and neighbors), paper and pencil, concrete materials, and technological tools such as calculators and computers.
2. states and uses multiplication facts up through the 5's plus the 10's as well as the corresponding division facts with efficiency and accuracy.
3. explains and performs the following computational procedures:
   whole number addition and subtraction up to the one hundred thousands place.
   multiplication of a two-digit number by a one-digit number, using mathematics facts appropriate for the grade level with and without concrete materials.
   addition and subtraction of monetary amounts using dollar and cents notation such as $47.07 + $356.96.
4. explains the relationship between addition and subtraction.
5. knows different ways to read and write the same multiplication expression such as: 6x4 is the same as 6 or the same as 6•4.
   x4.

Possible Third Grade Application Indicators

The student:

1. selects and uses computational procedures to formulate and solve real-world problems involving selected whole numbers and money.

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Standard 2: The student uses algebraic concepts and procedures in a variety of situations.

Benchmark 1: PATTERNS - The student recognizes, describes, extends, develops, and explains relationships in patterns from a variety of situations.

Fourth Grade Knowledge Base Indicators

Using concrete materials, drawings, or other representations, the student:

NΔ 1. identifies and continues patterns presented in a variety of formats: numeric, visual, oral, written, kinesthetic, pictorial, tabular, graphical, or listing.

For the purpose of assessing this indicator on the Kansas Assessment the student should be able to work with the following types of patterns:

whole number patterns both increasing and decreasing such as 20, 15, 10 . . . .

money and time patterns such as $.25, $.50, $.75 or 1:05 p.m., 1:10 p.m., 1:15 p.m.

number theory patterns, such as odds, evens, or multiples through 5's.

visual patterns involving two attributes.

measurement and geometric patterns such as 3 ft., 6 ft., 9 ft...

patterns occurring in daily life such as sports scores, longitude and latitude, elections, eras and other patterns, appropriate to grade level curriculum.

number theory patterns such as multiples and factors through 12 or multiplying by 10, 100, and 1000.

kinesthetic patterns such as clapping.

2. creates a pattern.

Special Note: Working with various types of patterns is an important precursor to working with functions and sequences in middle school and high school.

Possible Third Grade Knowledge Base Indicators

Using concrete materials, drawings, or other representations, the student:

1. identifies, states, and continues patterns presented in a variety of formats: numeric, visual, oral, written, kinesthetic, pictorial, tabular, graphical, or listing.
2. recognizes patterns involving two changes.
3. creates a pattern.

Fourth Grade Application Indicators

The student:

1. generalizes patterns using written descriptions.

NΔ 2. recognizes the same general pattern presented in different representations such as skip counting by five's to sixty, whole number multiples of five to sixty, and the five times tables give the same numerical pattern 5, 10, 15, . . . 60.

For the purpose of assessing this indicator on the Kansas Assessment the student should be able to work with the following types of patterns:

whole number patterns both increasing and decreasing such as 20, 15, 10 . . . .

money and time patterns such as $.25, $.50, $.75 or 1:05 p.m., 1:10 p.m., 1:15 p.m.

number theory patterns, such as odds, evens, or multiples through 5's.

visual patterns involving two attributes.

measurement and geometric patterns such as 3 ft., 6 ft., 9 ft...

patterns occurring in daily life such as sports scores, longitude and latitude, elections, eras and other patterns appropriate to grade level curriculum.

number theory patterns such as multiples and factors through 12 or multiplying by 10, 100, and 1000.

kinesthetic patterns such as clapping.

Possible Third Grade Application Indicators

The student:

1. generalizes patterns using written descriptions.
2. recognizes the same general pattern presented in different representations.

38

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A partial list of patterns to help students meet these indicators could include:
whole number patterns both increasing and decreasing (20, 15, 10).
money and time patterns ($.25, $.50, $.75 or 1:05 p.m., 1:10 p.m., 1:15 p.m.
patterns occurring in life such as seasons, temperature or weather, appropriate for grade level topics across the curriculum.
number theory patterns, such as: odd, evens, and multiples through 5's.
kinesthetic patterns such as clapping.
visual patterns involving two attributes.

Special Note: Working with various types of patterns is an important precursor to working with functions and sequences in middle school and high school.

Benchmark 2: VARIABLES, EQUATIONS, AND INEQUALITIES - The student uses symbols and whole numbers to solve simple equations and inequalities in a variety of situations.

Fourth Grade Knowledge Base Indicators

The student:

1. solves one-step equations in one unknown with a whole number solution such as finding any missing number in a multiplication or division equation based on the multiplication and division facts for numbers up to 12 times 12, equations involving time and money such as 8 quarters + 10 dimes = Δ dollars or 180 minutes = Δ hours and 100 x Δ = 600.
2. reads and writes whole number equations and inequalities using correct mathematical vocabulary and notation such as 15=3x5, fifteen equals three times five; 4<6, five is greater than three, 14,564>10,000, or fourteen thousand is greater than thirteen thousand twenty-five.

Fourth Grade Application Indicators

The student:

1. uses symbols to represent problem situations which involve unknown quantities.

NΔ 2. formulates and solves problem situations involving one-step equations in one unknown with a whole number solution.
For the purpose of assessing this indicator on the Kansas Assessment the student should be able to solve one-step equations in one unknown with a whole number solution such as finding any missing number in a multiplication or division equation based on the multiplication and division facts for numbers up to 12 times 12, equations involving time and money such as 8 quarters + 10 dimes = Δ dollars or 180 minutes = Δ hours and 100 x Δ = 600.

Possible Third Grade Knowledge Base Indicators

The student:

1. explains and uses symbols for unknown quantities.
2. solves equations involving only one operation up to 99.
3. finds missing multiplication facts and corresponding division facts through 5 and 10.
4. solves money equations up to a dollar.
5. compares two whole numbers between 0 and 999 using symbols (>,<, or =) and words (less

Possible Third Grade Application Indicators

The student:

1. uses symbols to represent problem situations which involve unknown quantities.
2. formulates and solves problem situations involving one-step equations in one unknown with a whole number solution.

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than, greater than, or equal to).

Benchmark 3: FUNCTIONS - The student recognizes and describes relationships between whole numbers in a variety of situations.

Fourth Grade Knowledge Base Indicators

The student:

1. uses a variety of methods to recognize relationships between whole numbers including mental mathematics, paper and pencil, concrete materials, and graphing utilities or other technological tools.
2. uses a T-table to find ordered pairs in a relationship.

NΔ 3. finds values and determines rules involving operations of whole numbers using input/output machines or T-tables.

4. identifies and graphs ordered pairs in the first quadrant.

Fourth Grade Application Indicators

The student:

NΔ 1. uses concrete items, symbols and equations, tables, graphs, pictures and written descriptions to represent and describe mathematical relationships.

2. generalizes patterns by stating the rule using symbol notation.

Possible Third Grade Knowledge Base Indicators

The student:

1. uses a variety of methods to recognize relationships between whole numbers including mental mathematics, paper and pencil, concrete materials, and graphing utilities or other technological tools.
2. generalizes patterns by stating the rule using symbol notation.
3. identifies and graphs ordered pairs in the first quadrant.
4. finds values and determines rules involving addition and subtraction of whole numbers using input/output machines or T-tables.

Possible Third Grade Application Indicators

The student:

1. uses concrete items, symbols and equations, tables, graphs, pictures and written descriptions to represent and describe mathematical relationships.

Benchmark 4: MODELS - The student develops and uses models to represent and justify mathematical relationships found in a variety of situations.

Fourth Grade Knowledge Base Indicators

The student:

NΔ 1. uses mathematical models to represent and explain mathematical concepts and procedures.
For the purpose of assessing this indicator on the Kansas Assessment the student should be able to work with the following types of models:
diagrams and pictures to model problem situations.
tables, charts, and graphs to organize and display data.
place value models to compare, order and represent whole numbers.

Fourth Grade Application Indicators

The student:

NΔ 1. recognizes the same situation can be represented in more than one way.
For the purpose of assessing this indicator on the Kansas Assessment the student should be able to:
a) represent the number of items in a specific category for a given data set by a horizontal bar graph, a vertical bar graph, a frequency table or a written description.
b) use process models for whole number operations such as multiplication arrays, division sets, the number line, and the

40

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process models for whole number operations such as multiplication arrays, division sets, the number line, and the hundreds chart.
money (coins), fraction models (fraction strips), decimal models (base ten blocks, coins) and mixed number models (pattern blocks) to compare, order or represent numerical quantities
Venn Diagrams to sort up to three attributes.
T-tables to find and show relationships between numbers.

2. creates mathematical models to show the relationship between two or more things.

Although not assessed on the Kansas Assessment, an additional model the student knows, explains, and uses simple tree diagrams for organizing attributes of sets and determining the number of possible combinations.

Possible Third Grade Knowledge Base Indicators

The student:

1. uses mathematical models to represent and explain mathematical concepts and procedures.
2. creates mathematical models to show the relationship between two or more things.

The student knows, explains, and uses mathematical models such as:
graphs using real objects, representational objects or abstract representations to display data.
place value models to compare, order and represent whole numbers.
process models for whole number operations such as multiplication arrays, division sets, the number line, and the hundreds chart.
money (coins), fraction models (fraction strips), decimal models (base ten blocks, coins) and mixed number models (patterns blocks) to compare, order or represent numerical quantities.
tables and charts to organize data.
Venn Diagrams to sort up to two attributes.
diagrams and pictures to represent problem situations.

hundreds chart.
c) use different combinations of coins or bills to represent a monetary amount.

Special Note: The mathematical modeling process involves:
a) selecting key features and relationships within the real world situation and representing these concepts in mathematical terms through some sort of mathematical model;
b) performing manipulations and mathematical procedures within the mathematical model;
c) interpreting the results of the manipulations within the mathematical model and using these results to make inferences about the original real-world situation.

Possible Third Grade Application Indicators

The student:

1. recognizes the same situation can be represented in more than one way such as using a Venn diagram, a written description or a frequency table to show how the objects from a given list fall into specific categories.

Special Note: The mathematical modeling process involves:
a) selecting key features and relationships within the real world situation and representing these concepts in mathematical terms through some sort of mathematical model;
b) performing manipulations and mathematical procedures within the mathematical model;
c) interpreting the results of the manipulations within the mathematical model and using these results to make inferences about the original real-world situation.

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Standard 3: The student uses geometric concepts and procedures in a variety of situations.

Benchmark 1: GEOMETRIC FIGURES AND THEIR PROPERTIES - The student recognizes or investigates properties of simple geometric figures in a variety of situations.

Fourth Grade Knowledge Base Indicators

The student:

1. uses appropriate technology, manipulatives, and drawings to recognize and investigate properties of simple geometric figures.
2. recognizes and describes the following geometric figures and their basic properties: rhombus, octagon, pentagon, circle, square, rectangle, triangle, and ellipse (oval).
3. recognizes and describes the following geometric solids: pyramid, triangular prism, rectangular prism, cylinder, cone, sphere and cube.
4. identifies faces, edges, vertices (corners) and bases on three-dimensional objects.
5. recognizes and describes similar and congruent figures.
6. identifies the radius and diameter of a circle.

Fourth Grade Application Indicators

The student:

1. formulates and solves real-world problems by applying basic properties of simple geometric figures.

NΔ 2. categorizes a composite figure into the shapes used to form it.

For the purpose of assessing this indicator on the Kansas Assessment the student should be able to recognize the following figures which were used to form a composite shape: square, rhombus, octagon, pentagon, circle, square, rectangle, triangle, and ellipse (oval).

Possible Third Grade Knowledge Base Indicators

The student:

1. uses appropriate technology, manipulatives or drawings to recognize and investigate properties of simple geometric figures.
2. recognizes and describes rhombus, octagon, pentagon.
3. recognizes and describes the following geometric figures: cylinder, cone, sphere and cube.
4. determines if a figure contains any lines of symmetry and draws them if they exist.
5. recognizes similar and congruent figures.

Possible Third Grade Application Indicators

The student:

1. formulates and solves real-world problems by applying basic properties of geometric figures.
2. combines several geometric shapes to make a larger shape.

Benchmark 2: MEASUREMENT AND ESTIMATION - The student estimates and measures using standard and nonstandard units in a variety of situations.

Fourth Grade Knowledge Base Indicators

The student:

1. uses appropriate estimation techniques to find whole number approximations of area, perimeter, length, width, distance, weight, temperature, capacity, or time.
2. finds the perimeter of two-dimensional figures given the measure of all the sides.
3. applies appropriate measurement techniques to find accurate representations for area,

Fourth Grade Application Indicators

The student:

NΔ 1. formulates and solves real-world problems by applying measurements and measurement formulas.

For the purpose of assessing this indicator on the Kansas Assessment the student should be able to work with the following measurements and conversions:

a) area of rectangles and squares.

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perimeter, length, width, distance, weight, volume, temperature and time.

NΔ 4. selects, explains the selection of, and uses measurement tools, units of measure, and degrees of accuracy appropriate to the given situation to measure length to the nearest fourth of an inch, nearest centimeter; volume to the nearest pint, cup, quart, gallon or liter and nonstandard units of measure to the nearest whole unit; weight to the nearest pound or ounce and nonstandard units of measure to the nearest whole unit; and temperature to the nearest degree; and units of time.

5. performs conversions within the same measurement system such as inches to feet, feet to yards, inches to yards, quarts to gallons, pints to quarts, cups to pints, pounds to ounces, or centimeters to meters.

b) perimeter.
c) length to the nearest fourth of an inch, nearest centimeter and nonstandard units of measure to the nearest whole unit; volume to the nearest pint, cup, quart, gallon or liter; temperature to the nearest degree; and weight to the nearest pound or ounce.
d) conversions within the same measurement system such as going back and forth between inches and feet, feet and yards, inches and yards, quarts and gallons, pints and quarts, cups and pints, pounds and ounces, or centimeters and meters.
e) units of time

2. uses estimation to check reasonableness of measurements and calculations.
3. adjusts original measurements based on additional information (estimation from a frame of reference).
4. uses map scales to measure distance between locations.

Possible Third Grade Knowledge Base Indicators

The student:

1. finds the perimeter of squares, rectangles, and triangles given the measure of all the sides.
2. selects, uses, or explains measurement tools and units of measure appropriate for the situation.
3. states the number of hours in a day and days in a year.
4. understands appropriate uses of length, width, height, and temperature.
5. measures length to the nearest half inch, to the nearest centimeter or nonstandard units of measure to nearest whole unit; volume to the nearest pint, cup, quart, gallon or liter; temperature to the nearest degree.
6. selects, explains the selection of, or uses measurement tools, units of measure, and degrees of accuracy appropriate to a given situation.
7. reads and tells time to the minute on analog and digital clocks.

Possible Third Grade Application Indicators

The student:

1. formulates and solves real-world problems by applying measurements and measurement formulas.
2. uses estimation to check reasonableness of measurements and calculations.
3. adjusts original measurements based on additional information (estimation from a frame of reference).
4. uses map scales to measure distance between locations.

Benchmark 3: TRANSFORMATIONAL GEOMETRY - The student recognizes up to two transformations of basic geometric figures in a variety situations.

Fourth Grade Knowledge Base Indicators

The student:

Fourth Grade Application Indicators

The student:

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NΔ 1. recognizes and performs up to two transformations (rotation/turn, reflection/flip, translation/slide) on simple two-dimensional shapes and uses cardinal or positional directions to describe translations such as move the triangle three units to the right and two units up.

1. describes or draws two-dimensional shapes as they would appear after undergoing a specified transformation without actually performing the transformation with concrete objects.
2. discusses what properties of basic shapes stay the same and what changes when a transformation is performed.
3. recognizes how pyramids, triangular prisms, and rectangular prisms would appear from a variety of visual perspectives (top, bottom, side, and corners).
4. gives or uses directions to move from one location to the another on a map or grid.

Possible Third Grade Knowledge Base Indicators

The student:

1. recognizes or performs one transformation (rotation/turn, reflection/flip, and translation/slide) on basic two-dimensional shapes.
2. knows and uses cardinal directions (north, south, east, west, northeast, southwest, etc.)

Possible Third Grade Application Indicators

The student:

1. describes or draws basic two-dimensional shapes as they would appear after undergoing a specified transformation without actually performing the transformation with concrete objects.
2. recognizes and explains real-life situations where transformations take place.
3. gives or uses directions to move from one location to another on a map.

Benchmark 4: GEOMETRY FROM AN ALGEBRAIC PERSPECTIVE - The student relates geometric concepts to the number line and the first quadrant of the coordinate plane in a variety of situations.

Fourth Grade Knowledge Base Indicators

The student:

1. uses the number line to represent the distance between two whole numbers.
2. graphs and identifies points in the first quadrant of the coordinate plane.
3. uses points on coordinate grids to identify locations.

Fourth Grade Application Indicators

The student:

NΔ 1. uses coordinate grids and maps to formulate and solve real world problems involving distance and location such as identifying locations and giving or following directions to move from one location to another.
For the purpose of assessing this indicator on the Kansas Assessment the student should be able to use maps and grids which have positive whole number or letter coordinates.

Possible Third Grade Knowledge Base Indicators

The student:

1. identifies points in the first quadrant of the coordinate plane.
2. uses two numbers or a letter and a number to identify points on a coordinate grid.

Possible Third Grade Application Indicators

The student:

1. uses coordinate grids to formulate and solve real-world problems, such as identifying locations and giving or following directions to move from one location to another.

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Standard 4: The student uses concepts and procedures of data analysis in a variety of situations.

Benchmark 1: PROBABILITY - The student uses probability to make predictions and decisions in a variety of situations.

Fourth Grade Knowledge Base Indicators

The student:

1. lists the possible outcomes of a simple experiment.
2. identifies the probability of a single event within a simple experiment such as three chances out of eight.

Fourth Grade Application Indicators

The student:

NΔ 1. compares what should happen (theoretical/expected results) with what did happen (experimental/empirical results) in a simple experiment.

2. conducts simple experiments and/or simulations involving a single event, records the results in charts, tables, or graphs, and uses the results to draw conclusions about the event and make predictions about future events.

Possible Third Grade Knowledge Base Indicators

The student:

1. lists some of the possible outcomes of a simple experiment.
2. recognizes whether the outcome of an event is impossible, certain, likely, or unlikely.

Possible Third Grade Application Indicators

The student:

1. conducts experiments and simulations involving a simple event, records the results in a chart, table or graph, and uses the results to draw conclusions about the event.

Benchmark 2: STATISTICS - The student generates, organizes, and interprets whole number and other data in a variety of situations.

Fourth Grade Knowledge Base Indicators

The student:

NΔ 1. organizes, displays and reads numerical (quantitative) and non-numerical (qualitative) data in a clear, organized and accurate manner including correct titles, labels, categories or whole number intervals.
For the purpose of assessing this indicator on the Kansas Assessment the student should know, explain, or use any of the following data displays:
frequency tables.
horizontal and vertical bar graphs.
Venn diagrams or other pictorial displays.
charts and tables.
line graphs.
pictographs.

2. determines and conducts sampling techniques (observations, surveys, random sampling) for gathering data.

NΔ 3. identifies, explains or calculates the following

Fourth Grade Application Indicators

The student:

NΔ 1. uses data analysis to make reasonable inferences, decisions/predictions, and to develop convincing arguments from data displayed in a variety of formats. (see listing of graphical displays)
For the purpose of assessing this indicator on the Kansas Assessment the student should be able to:
a) work with any of the following data displays:
frequency tables.
horizontal and vertical bar graphs.
Venn diagrams or other pictorial displays.
charts and tables.
line graphs.
pictographs.
b) use any of the following statistical measures of a whole number data set:
maximum value, minimum value, range, mode, mean (average) when the data set has a

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statistical measures of a data set composed of whole number data values: maximum value, minimum value, range, mean (average) when the data set has a whole number mean, the median for a data set having an odd number of data points and the mode for any data set.

whole number mean, and the median for a data set having an odd number of data points.
c) use various scales and formats to display the same data set.

2. recognizes or explains the affects of scale and/or interval changes on graphs of whole number data sets.
3. recognizes that the same data set can be displayed in a variety of formats (i.e. Different display formats for the same data set can look different, but still be the same data set.)

Possible Third Grade Knowledge Base Indicators

The student:

1. organizes, displays and reads numerical (quantitative) and non-numerical (qualitative) data in a clear, organized and accurate manner including correct titles, labels, categories or whole number intervals. Specific graphical displays of whole number, monetary unit, and categorical data include:
   - frequency tables.
   - horizontal and vertical bar graphs.
   - Venn diagrams and other pictorial displays.
   - charts and tables.
   - line graphs.
   - pictographs.
2. knows, explains, and conducts sampling techniques (observations, polls, tally marks, and interviews) for gathering data.
3. ranks the values of a data set containing whole numbers.
4. identifies mode for a data set containing whole numbers.
5. calculates the range for a whole number data set.

Possible Third Grade Application Indicators

The student:

1. uses data analysis to make reasonable inferences, predications, answer questions, and make decisions from data displayed in a variety of formats. (See listing of graphical displays.)
2. recognizes that the same data set can be displayed in a variety of formats. (i.e. Different display formats for the same data set can look different, but still be the same data set.)

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Standard 1: The student uses numerical and computational concepts and procedures in a variety of situations.

Benchmark 1: NUMBER SENSE - The student demonstrates number sense for rational numbers, pi, and simple algebraic expressions in one variable in a variety of situations.

Seventh Grade Knowledge Base Indicators

The student:

1. compares and orders rational numbers and pi, and explains the relative magnitude among them.

Special Note: Remember, rational numbers include large numbers such as one million and small numbers such as one thousandth.

2. knows, explains, and uses equivalent representations for rational numbers: integers, decimals, fractions, percents, ratios, numbers with whole number exponents, and scientific notation.
3. explains and determines the absolute value of rational numbers.
4. knows, explains, and uses equivalent representations for the same simple algebraic expressions such as 2x + 5x could be written as 7x.

NΔ 5. knows and explains what happens to the product or quotient when a number is multiplied or divided by a number between zero and one or a number greater than one.

Seventh Grade Application Indicators

The student:

Δ 1. uses appropriate representations of rational numbers, pi, and simple algebraic expressions to formulate and solve real-world problems. *For the purpose of assessing this indicator on the Kansas Assessment the student should be able to use equivalent representations for rational numbers: integers, decimals, fractions, percents, ratios, numbers with whole number exponents, and scientific notation.*

Special Note: Remember, rational numbers include large numbers such as one million and small numbers such as one-thousandth.

2. determines reasonableness of solutions to problems involving rational numbers, pi and simple algebraic expressions.

Possible Sixth Grade Knowledge Base Indicators

The student:

1. compares and orders decimals and fractions greater than zero and integers, and explains the relative magnitude among them.
2. knows, explains, and uses equivalent representations for fractions and decimals.
3. knows and explains relationships between percents and ratios.
4. knows, explains, and uses whole number exponents.
5. uses equivalent representations for the same simple algebraic expression such as x+x+x could be written as 3x.

Possible Sixth Grade Application Indicators

The student:

1. uses appropriate representations of positive rational numbers to formulate and solve real-world problems.
2. determines reasonableness of solutions to problems involving rational numbers greater than or equal to zero.

Possible Fifth Grade Knowledge Base Indicators

The student:

1. compares and orders whole numbers, decimals and fractions greater than zero, and explains the relative magnitude among them.
2. identifies integers and gives real-world

Possible Fifth Grade Application Indicators

The student:

1. uses appropriate representations of whole numbers, decimals and fractions to formulate and solve real-world problems.
2. determines reasonableness of solutions to

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situations where integers are used.

3. uses equivalent representations for the same whole number, decimals, and simple fractions (thirds, halves, fourths, tenths and hundredths).

problems involving whole numbers, decimals and fractions greater than or equal to zero.

Benchmark 2: NUMBER SYSTEMS AND THEIR PROPERTIES - The student demonstrates an understanding of the rational number system and pi, recognizes, applies, and explains its properties, and extends these properties to algebraic expressions in one variable.

Seventh Grade Knowledge Base Indicators

The student:

1. recognizes the need for rational numbers and pi.
2. classifies rational numbers as members of various number systems.
3. knows or explains the relationships among natural (counting) numbers, whole numbers, integers, and rational numbers (models include number lines, Venn diagrams).
4. knows the correct terminology for, explains, and uses: addition and multiplication properties of equality; commutative, associative, distributive, and substitution properties, additive and multiplicative identity properties; additive and multiplicative inverse properties; multiplicative property of zero; transitive, reflexive and symmetric properties; transitive property of inequality; and the addition property of inequality.

Seventh Grade Application Indicators

The student:

Δ 1. uses properties of the rational number system and pi to explain reasoning, and to formulate and solve real-world problems.
For the purpose of assessing this indicator on the Kansas Assessment the student should be able to use any of the following properties: addition and multiplication properties of equality; commutative, associative, distributive, and substitution properties, additive and multiplicative identity properties; additive and multiplicative inverse properties; multiplicative property of zero; transitive, reflexive and symmetric properties; transitive property of inequality; and the addition property of inequality.

2. uses rational number properties to perform various computational procedures and explains how they were used.

Possible Sixth Grade Knowledge Base Indicators

The student:

1. recognizes the need for integers.
2. understands that counting numbers, whole numbers, fractions, mixed numbers, and decimals are rational numbers.
3. identifies and explains prime and composite numbers.
4. uses the following properties: commutative and associative properties for addition and multiplication; the distributive property; additive and multiplicative identities; additive inverse; multiplicative property of equality; additive property of equality; and the reflexive, transitive, and symmetric properties of equalities.

Possible Sixth Grade Application Indicators

The student :

1. uses properties of the rational number system to explain reasoning and to formulate and solve real-world problems.
2. uses rational number properties to perform various computational procedures and explains how they were used.

Possible Fifth Grade Knowledge Base Indicators

The student:

1. recognizes the need for decimals and fractions.
2. classifies various types of numbers as whole

Possible Fifth Grade Application Indicators

The student:

1. uses properties of the rational number system to explain their reasoning, formulate and solve

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numbers, mixed numbers, fractions, and decimals.
3. recognizes Roman Numerals that are used for dates, on clock faces, and in outlines.
4. identifies prime and composite numbers to 50.
5. uses the following properties: commutative and associative properties for addition and multiplication; the substitution property; additive and multiplicative identity properties; and the symmetric property of equality.

real-world problems.
2. uses rational number properties to perform various computational procedures and explains how they were used.

Benchmark 3: ESTIMATION - The student uses numerical estimation with rational numbers and pi in a variety of situations.

Seventh Grade Knowledge Base Indicators

The student:

1. uses a variety of computational methods including mental mathematics, paper and pencil, concrete materials, or technological tools such as calculators and computers to estimate quantities involving rational numbers and pi.
2. estimates quantities involving rational numbers and pi using various estimation techniques such as rounding, special numbers, clustering, truncation, and compatible numbers.
3. recognizes and explains the difference between exact and approximate values of rational numbers and pi.
4. discusses the appropriateness of the estimation strategy used and its impact on the result.

Seventh Grade Application Indicators

The student:

Δ 1. uses estimation to check reasonableness of results, and makes predictions in situations involving rational numbers, pi and simple algebraic expressions.
For the purpose of assessing this indicator on the Kansas Assessment the student should be able to estimate quantities involving rational numbers and pi using various estimation techniques such as rounding, special numbers, clustering, truncation, and compatible numbers.

2. adjusts original rational number estimates based on additional information (estimation from a frame of reference).

Δ 3. determines if a problem situation calls for an exact or approximate answer and performs the appropriate computation with rational numbers and pi. *See benchmark 4 for computation expectations.*

Possible Sixth Grade Knowledge Base Indicators

The student:

1. uses a variety of computational methods including mental mathematics, paper and pencil, concrete materials, and technological tools such as calculators and computers to estimate quantities involving rational numbers.
2. estimates quantities involving rational numbers using various estimation techniques such as rounding, special numbers, clustering, truncation or compatible numbers.
3. recognizes and explains the difference between exact and approximate values.

Possible Sixth Grade Application Indicators

The student:

1. uses estimation to check reasonableness of results, and makes predictions in situations involving rational numbers and pi.
2. adjusts original rational number estimates based on additional information (estimation from a frame of reference).
3. determines if a problem situation calls for an exact or approximate answer and performs the appropriate computation.

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4. explains the estimation strategy implemented and its impact on the result.

Possible Fifth Grade Knowledge Base Indicators

The student:

1. uses a variety of computational methods including mental mathematics, paper and pencil, concrete materials and technological tools such as calculators and computers to estimate quantities involving whole numbers, fractions including mixed numbers, decimals and money.
2. uses various estimation techniques such as front-end with adjustment, rounding, special numbers, clustering, and compatible numbers to estimate quantities involving whole numbers, fractions including mixed numbers, decimals and money.
3. recognizes and explains the difference between exact and approximate values.
4. explains the estimation strategy implemented and its possible impact on the result.

Possible Fifth Grade Application Indicators

The student:

1. uses estimation to check reasonableness of results, and makes predictions in situations involving whole numbers, fractions including mixed numbers, decimals and money.
2. adjusts original rational number estimates based on additional information (estimation from a frame of reference).
3. determines if a problem situation calls for an exact or approximate answer and performs the appropriate computation.

Benchmark 4: COMPUTATION - The student explains and performs computations with rational numbers, pi and first degree algebraic expressions in one variable in a variety of situations.

Seventh Grade Knowledge Base Indicators

The student:

1. uses a variety of computational methods including mental arithmetic (doubles and neighbors), paper and pencil, concrete materials, or technological tools such as calculators and computer.

NΔ 2. explains and performs computations with rational numbers, pi, and first degree algebraic expressions in one variable.

For the purpose of assessing this indicator on the Kansas Assessment the student should be able to perform the following computations without the aid of calculators, abacuses, or computers:

addition, subtraction, multiplication and division of rational numbers with a special emphasis on fractions.

simplification of expressions using the correct order of operations.

express answers in simplest form.

find percentages of numbers.

find roots of perfect whole number squares.

simplification and evaluation of positive rational numbers raised to positive whole

Seventh Grade Application Indicators

The student:

Δ 1. uses arithmetic operations and inverse relationships to formulate and solve real-world problems involving rational numbers, pi and first degree algebraic expressions in one variable.

For the purpose of assessing this indicator on the Kansas Assessment the student should be able to perform the following computations:

addition, subtraction, multiplication and division of rational numbers with a special emphasis on fractions.

simplification of expressions using the correct order of operations.

express answers in simplest form.

find percentages of numbers.

simplification and evaluation of positive rational numbers raised to positive whole number powers.

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number powers.

Although not assessed on the Kansas Assessment, the student also explains and performs the following computations:
combine like terms of a first degree algebraic expression in one variable.
find roots of perfect whole number cubes intuitively.

3. recognizes, explains, and uses different ways to express arithmetic operations.
4. analyzes and explains computational procedures including the use of more than one arithmetic approach to perform a computation such as 49x23 = (40x23)+(9x23) or 49x23 = (49x20) + (49x3) or 49x23 = (50x23) - 23.

Possible Sixth Grade Knowledge Base Indicators

The student:

1. uses a variety of computational methods including mental arithmetic (doubles and neighbors), paper and pencil, concrete materials, or technological tools such as calculators and computers.
2. explains and performs: whole number division and expresses remainders as decimals; addition, subtraction, multiplication and division with decimals; addition and subtraction with integers; and addition, subtraction, and multiplication with fractions and mixed numerals, expressing answers in simple form.
3. identifies, explains, and finds the greatest common factor and least common multiple of two or more whole numbers.
4. identifies, explains, and finds the prime factorization of whole numbers.
5. combines like terms of simple algebraic expressions.

Possible Sixth Grade Application Indicators

The student:

1. uses arithmetic operations and inverse relationships to formulate and solve real-world problems involving selected rational numbers.

Possible Fifth Grade Knowledge Base Indicators

The student:

1. uses a variety of computational methods including mental arithmetic (doubles and neighbors), paper and pencil, concrete materials, or technological tools such as calculators and computers.
2. explains and performs whole number division and expresses remainders as a whole number or a fractional part; addition, subtraction and multiplication of decimals; addition and subtraction of fractions and mixed numbers without regrouping and expresses answers in

Possible Fifth Grade Application Indicators

The student:

1. uses arithmetic operations and inverse relationships to formulate and solve real-world problems involving selected rational numbers.

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simplest form.

3. finds factors and multiples of whole numbers

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Standard 2: The student uses algebraic concepts and procedures in a variety of situations.

Benchmark 1: PATTERNS - The student recognizes, describes, extends, develops, and explains the general rule of patterns from a variety of situations.

Seventh Grade Knowledge Base Indicators

The student:

NΔ 1. identifies and continues patterns presented in a variety of formats: numeric, algebraic, visual, oral, written, kinesthetic, pictorial, tabular, graphical, or listing.
For the purpose of assessing this indicator on the Kansas Assessment the student should be able to work with the following types of patterns:
rational number patterns.
patterns established by using units of measure.
patterns based on geometric shapes.
simple arithmetic and geometric sequences involving whole numbers.
patterns occurring in nature.
number patterns involving squares, cubes, and reciprocals.
numerical and geometric patterns including perfect squares, multiples, and arithmetic sequences using grade appropriate numbers.

2. recognizes patterns with two simultaneous changes.
3. creates a pattern.

Special Note: Working with various types of patterns is an important precursor to working with functions and sequences in high school.

Seventh Grade Application Indicators

The student:

Δ 1. generalizes a pattern by using a written description.
For the purpose of assessing this indicator on the Kansas Assessment the student should be able to work with the following types of patterns:
rational number patterns.
patterns established by using units of measure.
patterns based on geometric shapes.
simple arithmetic and geometric sequences involving whole numbers.
patterns occurring in nature.
number patterns involving squares, cubes, and reciprocals.
numerical and geometric patterns including perfect squares, multiples, and arithmetic sequences using grade appropriate numbers.

2. generalizes a pattern expressed in a recursive nature.
3. recognizes the same general pattern presented in different representations.

Possible Sixth Grade Knowledge Base Indicators

The student:

1. identifies and continues patterns presented in a variety of formats: numeric, algebraic, visual, oral, written, kinesthetic, pictorial, tabular, graphical, or listing.
2. creates a pattern.
3. recognizes patterns involving simultaneous change.

A partial list of patterns to help students meet these indicators could include:
everyday life patterns appropriate for grade level across the curriculum.
numerical and geometric patterns including perfect squares, multiples, and arithmetic

Possible Sixth Grade Application Indicators

The student:

1. generalizes a pattern using a written description.
2. generalizes a pattern using symbolic notation when possible.
3. recognizes the same general pattern presented in different representations.

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sequences using grade appropriate numbers.

Special Note: Working with various types of patterns is an important precursor to working with functions and sequences in high school.

Possible Fifth Grade Knowledge Base Indicators

The student:

1. identifies, states, and continues patterns presented in a variety of formats: numeric, visual, oral, written, kinesthetic, pictorial, tabular, graphical, or listing.
2. recognizes patterns involving two changes.
3. creates a pattern.

A partial list of patterns to help students meet these indicators could include:
numerical and geometric patterns including patterns formed by powers of ten (place value) and arithmetic sequences using grade appropriate numbers such as (2, 5, 8, ...).
kinesthetic patterns.
everyday life patterns appropriate for grade level across the curriculum.

Special Note: Working with various types of patterns is an important precursor to working with functions and sequences in middle school and high school.

Possible Fifth Grade Application Indicators

The student:

1. generalizes a pattern using a written description.
2. recognizes the same general pattern presented in different representations.

Benchmark 2: VARIABLES, EQUATIONS, AND INEQUALITIES - The student uses variables, symbols, rational numbers, and simple algebraic expressions in one variable to solve linear equations and inequalities in a variety of situations.

Seventh Grade Knowledge Base Indicators

The student:

1. knows and explains that a variable can represent a single quantity that changes such as daily temperature.
2. shows and explains how changes in one variable affects other variables such as changes in diameter affects circumference
3. explains the difference between an equation and an expression.
4. explains and uses the following words and symbols to represent relationships such as <, ≤, >, ≥, =, ≠, and greater than or equal to.
5. solves two-step linear equations in one variable with whole number coefficients and constants, and positive rational solutions.
6. solves two-step linear inequalities in one variable with whole number coefficients and

Seventh Grade Application Indicators

The student:

1. uses symbols, variables, expressions, inequalities, equations and simple systems of equations to represent problem situations which involve variable or unknown quantities.

Δ 2. formulates and solves problems involving simple linear relationships, finding percents of a given number, variable situations and unknown quantities.
For the purpose of assessing this indicator on the Kansas Assessment the student should be able to solve two-step linear equations in one variable with whole number coefficients and constants, and positive rational solutions as well as two-step linear inequalities in one variable with whole number coefficients and constants, and positive rational solutions

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constants, and positive rational solutions intuitively, analytically, and graphically such as $2x + 1 > 9$.

7. solves one-step linear equations in one variable.

Δ 8. evaluates formulas using substitution.

NΔ 9. knows and explains the relationship between ratios, proportions and percents including solving for a missing term in a proportion.

10. represents solution sets of linear equations in two variables on the coordinate plane.

intuitively, analytically, and graphically.

Possible Sixth Grade Knowledge Base Indicators

The student:

1. explains and uses symbols to represent unknown quantities and variable relationships.
2. solves one-step linear equations in one variable with positive whole number solutions such as $2x=8$ or $x+7=12$.
3. solves one-step whole number linear inequalities in one variable such as for what values of x is $3x > 12$.
4. finds a whole number percentage of a number such as what is 10% of 40?
5. explains and uses the relationship among ratios, proportions, and percents.

Possible Sixth Grade Application Indicators

The student:

1. uses symbols, variables, inequalities, and equations to represent problems involving variable situations and unknown quantities.
2. formulates and solves problems involving simple linear relationships, percents, variable situations and unknown quantities.

Possible Fifth Grade Knowledge Base Indicators

The student:

1. explains and uses symbols to represent unknown quantities and variable relationships.
2. explains and uses the following symbols: $=$, $<$, $>$, $\neq$, $\leq$, $\geq$.
3. solves one-step linear equations involving one unknown.
4. solves one-step linear inequalities involving one unknown.

Possible Fifth Grade Application Indicators

The student:

1. uses symbols, variables, inequalities, and equations to represent problems involving variable situations and unknown quantities.
2. formulates and solves problems involving linear relationships and unknown quantities.

Benchmark 3: FUNCTIONS - The student recognizes, describes, and examines constant and linear relationships in a variety situations.

Seventh Grade Knowledge Base Indicators

The student:

1. uses a variety of methods including mental mathematics, paper and pencil, concrete materials, and graphing utilities or other technological tools to recognize and examine constant and linear relationships.
2. explains or gives examples of relationships which remain constant.
3. uses ordered pairs to demonstrate relationships.

Seventh Grade Application Indicators

The student:

1. represents a variety of relationships using tables, graphs, verbal rules and when possible symbolic notation.

Δ 2. converts between numerical, tabular, graphical and verbal rules used to represent relationships.

Δ This indicator will be assessed at the state level.
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Indicators are not listed in priority order, nor are they considered as all inclusive.

Possible Sixth Grade Knowledge Base Indicators

The student:

1. identifies or graphs ordered pairs on the coordinate plane using a variety of scales.
2. uses ratios to describe relationships.

Possible Sixth Grade Application Indicators

The student:

1. converts between verbal, numerical, and graphical models or concrete materials used to describe mathematical relationships

Possible Fifth Grade Knowledge Base Indicators

The student:

1. uses letters and symbols to describe whole number relationships.

Possible Fifth Grade Application Indicators

The student:

1. converts between verbal, numerical, and graphical models or concrete materials used to describe mathematical relationships

Benchmark 4: MODELS - The student develops and uses models to represent and justify mathematical relationships found in a variety of situations.

Seventh Grade Knowledge Base Indicators

The student:

1. uses mathematical models to represent and explain mathematical concepts and procedures.

Δ 2. identifies mathematical models to show the relationship between two or more things.

For Kansas assessment purposes the student could be asked to work with the following types of models:

the number line to model the relationship between rational numbers or rational number operations.

Venn Diagrams to show the relationship between characteristics of two or more sets.

graphs, tables, and charts to organize, interpret or analyze rational number data.

scale drawings.

three-dimensional geometric models.

the coordinate plane to model ordered pairs and linear equations.

diagrams, flowcharts, or pictures to represent problem situations.

Although not assessed on the Kansas assessments, additional models for the student to know, explain, and use are:

equations and inequalities to model numerical relationships between data sets.

tessellations to reinforce patterns, area, and transformations.

geometric or numerical models to reinforce probability.

concrete materials to model the relationship between decimals, percents and fractions.

manipulatives to model computation.

factor trees.

Seventh Grade Application Indicators

The student:

1. recognizes that the same situation can be represented in more than one way such as using a table of values, a graph or an equation to represent the amount of money it would take to buy x number of CD's if CD's were $10 each.
2. explains why some models are more accurate than others in certain situations.
3. uses the mathematical modeling process to make inferences about real world situations when the mathematical model used to represent the situation is given.

Special Note: The mathematical modeling process involves:

a) selecting key features and relationships within the real world situation and representing these concepts in mathematical terms through some sort of mathematical model;

b) performing manipulations and mathematical procedures within the mathematical model;

c) interpreting the results of the manipulations within the mathematical model and using these results to make inferences about the original real-world situation.

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pictures and diagrams to model division of rational numbers.

Possible Sixth Grade Knowledge Base Indicators

The student:

1. uses mathematical models to represent and explain mathematical concepts and procedures.
2. creates mathematical models to show the relationship between two or more things.

The student knows, explains, and uses mathematical models such as:

the number line to model the relationship between rational numbers and rational number operations.

Venn diagrams to show the relationships between characteristics of two or more sets.

pictorial representations of addition and subtraction of rational numbers with regrouping.

equations and inequalities to model numerical relationships.

manipulatives or pictures to model computational procedures.

three-dimensional geometric models.

graphs, tables, and charts to describe, interpret or analyze data.

diagrams or pictures to represent problem situations.

Possible Sixth Grade Application Indicators

The student:

1. recognizes that the same situation can be represented in more than one way.
2. explains why some models are more useful than others in certain situations.

Possible Fifth Grade Knowledge Base Indicators

The student:

1. uses mathematical models to represent and explain mathematical concepts and procedures.
2. creates mathematical models to show the relationship between two or more things.

The student knows, explains, and uses mathematical models such as:

the number line to model the relationship between rational numbers and rational number operations.

Venn diagrams to show the relationships between characteristics of two or more sets.

pictorial representation of addition, subtraction of rational number with regrouping.

equations and inequalities to model numerical relationships.

manipulatives or pictures to model computational procedures.

three-dimensional geometric models.

graphs, tables, and charts to describe, interpret

Possible Fifth Grade Application Indicators

The student:

1. recognizes that the same situation can be represented in more than one way.
2. explains why some models are more useful than others in certain situations.

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or analyze data.
diagrams or pictures to model problem situations.

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Standard 3: The student uses geometric concepts and procedures in a variety of situations.

Benchmark 1: GEOMETRIC FIGURES AND THEIR PROPERTIES - The student recognizes, applies, and compares properties of geometric figures in a variety of situations.

Seventh Grade Knowledge Base Indicators

The student:

1. recognizes and uses properties of all geometric figures listed previously, plus the following figures: trapezoid and parallelogram.
2. classifies triangles as scalene, isosceles, equilateral, acute, right, obtuse, and equiangular, and polygons as regular, irregular, and/or by the number of sides.
3. recognizes or applies properties of corresponding parts of similar and congruent triangles and quadrilaterals.
4. uses symbols for perpendicular, parallel, triangle, and right angle.
5. uses appropriate technology, manipulatives, constructions or drawings to recognize or compare geometric figures.
6. determines if a triangle can be constructed from three different lengths.

Seventh Grade Application Indicators

The student:

Δ 1. formulates and solves real-world problems by applying properties of geometric figures.
For the purpose of assessing this indicator on the Kansas Assessment the student is able to:
a) apply angle and side properties of squares, rectangles, triangles, trapezoids, and parallelograms such as the opposite sides of a parallelogram are equal and parallel or a right triangle has one angle which is 90° or the sum of the angles of a triangle equals 180°.
Students do NOT need to be able to use the Pythagorean theorem.
b) classify triangles as scalene, isosceles, equilateral, acute, right, obtuse, and equiangular, and polygons as regular, irregular, and/or by the number of sides.
c) use symbols for perpendicular, parallel, triangle, and right angle.
d) use drawings to recognize or compare geometric figures.
e) determine the radius or diameter of a circle.

Possible Sixth Grade Knowledge Base Indicators

The student:

1. recognizes all geometric figures listed in previous benchmarks and indicators plus the following figures, rays and angles as right, acute, obtuse, and straight.
2. recognizes triangles as scalene, isosceles, and equilateral.
3. recognizes regular and irregular polygons.
4. recognizes similar and congruent triangles and quadrilaterals.
5. uses symbols for angle, line, line segment, and ray.
6. uses appropriate technology, manipulatives, constructions or drawings to recognize, apply or compare geometric figures.
7. recognizes parallel lines.

Possible Sixth Grade Application Indicators

The student:

1. formulates and solves real-world problems by applying properties of geometric figures.

Possible Fifth Grade Knowledge Base Indicators

The student:

1. uses appropriate technology, manipulatives, or drawings to recognize and investigate

Possible Fifth Grade Application Indicators

The student:

1. formulates and solves real-world problems by applying properties of geometric figures.

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properties of simple geometric figures.
2. recognizes and describes regular polygons having up to ten sides.
3. recognizes an ellipse.
4. recognizes, draws or describes points, lines, line segments, rays, and angles as right, obtuse or acute.
5. identifies and explains circumference, radius, and diameter.
6. identifies faces, edges, and bases on three dimensional objects.
7. recognizes perpendicular lines.

Benchmark 2: MEASUREMENT AND ESTIMATION - The student estimates, measures, and uses measurement formulas in a variety of situations.

Seventh Grade Knowledge Base Indicators

The student:

1. uses various estimation techniques to determine rational number approximations of length, volume, surface area, area, perimeter, weight, capacity, temperature or time.
2. recognizes, states and uses measurement formulas for perimeter and area of parallelograms, triangles, squares, rectangles, and circles plus the volume of a cube.

NΔ 3. applies measurement formulas which are given to three-dimensional figures including surface area of cubes and volume and surface area of rectangular prisms.

4. finds area and perimeter of two-dimensional figures composed of squares, rectangles, triangles, and circles.
5. applies various measurement techniques and uses appropriate tools, units of measure and degree of accuracy to find accurate rational number representations for length, volume, surface area, area, perimeter, weight, temperature and time.
6. uses appropriate units to describe rate as a unit of measure such as miles per hour.
7. finds missing angle measurements in triangles and quadrilaterals.
8. performs conversions within the standard measurement system.
9. performs conversions within the metric measurement system.

Seventh Grade Application Indicators

The student:

Δ 1. formulates and solves real-world problems by applying measurements and measurement formulas.

For the purpose of assessing this indicator on the Kansas Assessment the student should be able to:

a) recognize, state, and use measurement formulas for perimeter and area of parallelograms, triangles, squares, rectangles, and circles plus the volume of a cube.

b) apply measurement formulas which are given to three-dimensional figures including surface area of cubes and volume and surface area of rectangular prisms.

c) find area and perimeter of two-dimensional figures composed of squares, rectangles, triangles, and circles.

d) apply various measurement techniques and uses appropriate tools, units of measure and degree of accuracy to find accurate rational number representations for length, volume, surface area, area, perimeter, weight, temperature and time.

e) use appropriate units to describe rate as a unit of measure. example: miles per hour

f) find missing angle measurements in triangles and quadrilaterals.

g) perform conversions within the standard or metric measurement system.

2. uses estimation to check reasonableness of measurements and calculations and/or adjusts original measurements based on additional information (estimation from a frame of reference).

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Possible Sixth Grade Knowledge Base Indicators

The student:

1. uses various estimation techniques to determine whole number approximations of length, volume, area, perimeter, weight, capacity, temperature and time.
2. recognizes and states measurement formulas for areas and perimeters of squares and rectangles.
3. applies given measurement formulas including area and perimeter to two-dimensional figures.
4. applies various measurement techniques and uses appropriate tools, units of measure, and degrees of accuracy to find accurate rational number representations for length, area, perimeter, temperature and time.
5. performs conversions within standard measurement systems.
6. performs conversions within the metric measurement system such as millimeters to meters.
7. uses standard units of measurement up to the nearest sixteenth of an inch, metric measurements up to the nearest millimeter.
8. selects, explains the selection, or uses measurement tools, units of measure, and degrees of accuracy appropriate to the given situation.

Possible Sixth Grade Application Indicators

The student:

1. formulates and solves real-world problems by applying measurements and measurement formulas.
2. uses estimation to check reasonableness of measurements and calculations and/or adjusts original measurements based on additional information (estimation from a frame of reference).

Possible Fifth Grade Knowledge Base Indicators

The student:

1. knows and uses area and perimeter formulas for rectangles and squares.
2. uses standard units of measurement to the nearest eighth and fourth inch, metric measurement to the nearest whole centimeter, meter, and kilometer, or nonstandard unit of measure to the nearest whole unit.
3. selects, explains the selection of, or uses measurement tools, units of measure and degrees of accuracy appropriate to the given situation.
4. performs conversions within the standard and metric measurement systems such as millimeters to centimeters.

Possible Fifth Grade Application Indicators

The student:

1. formulates and solves real-world problems by applying measurements and measurement formulas.
2. uses estimation to check reasonableness of measurements and calculations.
3. adjusts original measurements based on additional information (estimation from a frame of reference).
4. uses map scales to measure distance between locations and makes simple scale drawings using grid paper.

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Benchmark 3: TRANSFORMATIONAL GEOMETRY - The student recognizes and performs transformations of two-dimensional figures in a variety situations.

Seventh Grade Knowledge Base Indicators

The student:

Δ 1. recognizes, describes, and performs single and multiple transformations [rotation, reflection, translation, shrink or magnify (dilate)] on two-dimensional figures.

2. creates a tessellation.

Δ 3. recognizes and draws three-dimensional shapes as they would appear from a variety of visual perspectives (top, bottom, side, and corners).

Seventh Grade Application Indicators

The student:

Δ 1. uses a scale drawing to determine the actual dimensions/measurements of the figure represented in the drawing.

2. explains the impact of transformation on area and perimeter of squares and rectangles.

3. uses transformations to examine symmetrical and congruence properties of geometric figures.

Possible Sixth Grade Knowledge Base Indicators

The student:

1. recognizes, explains and performs up to two transformations on two-dimensional figures.

2. recognizes a tessellation.

3. recognizes or draws three-dimensional shapes as they would appear from a variety of visual perspectives (top, bottom, side).

Possible Sixth Grade Application Indicators

The student:

1. describes and draws two dimensional shapes as they would appear after undergoing two specified transformations without actually performing the transformations with concrete objects.

Possible Fifth Grade Knowledge Base Indicators

The student:

1. recognizes, explains and performs up to two transformations on two-dimensional figures.

2. recognizes how pyramids, triangular prisms, rectangular prisms, cylinders, cones, and spheres would appear from a variety of visual perspectives (top, bottom, side, and corners).

Possible Fifth Grade Application Indicators

The student:

1. describes and draws two-dimensional shapes as they would appear after undergoing two specified transformations without actually performing the transformations with concrete objects.

Benchmark 4: GEOMETRY FROM AN ALGEBRAIC PERSPECTIVE - The student will analyze two-dimensional geometry using a coordinate system in a variety of situations.

Seventh Grade Knowledge Base Indicators

The student:

1. uses a variety of methods including mental mathematics, paper and pencil, concrete materials, graphing utilities and other technological tools to analyze two-dimensional geometry on the coordinate system.

NΔ 2. uses the coordinate plane to:

a) identify in which quadrant or on which axis a point lies when given the coordinates of the point.

b) graph or identify points on the coordinate plane in all four quadrants.

c) determine if a given point is on the line given the graph of the line.

d) list up to five coordinate pairs on the

Seventh Grade Application Indicators

The student:

1. represents, formulates and solves distance problems using a number line.

2. represents, formulates and solves area and perimeter problems involving squares, rectangles, and triangles on the coordinate plane.

3. represents, formulates and solves real world geometry problems by using algebraic notation, equations, or inequalities.

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graph of a line and then state the pattern that exists.

3. finds the distance between the points on a number line by computing the absolute value of their difference.

Possible Sixth Grade Knowledge Base Indicators

The student:

1. graphs or identifies points on the coordinate plane in the first quadrant.
2. uses T-tables.
3. recognizes and plots ordered pairs on the coordinate plane.
4. explains relationships among mixed numbers and decimals as they appear on a number line.

Possible Sixth Grade Application Indicators

The student:

1. represents, formulates and solves distance problems by using a number line.
2. represents, formulates and solves area and perimeter problems on the coordinate plane.

Possible Fifth Grade Knowledge Base Indicators

The student:

1. explains the relationships among fractions, whole numbers, and where they appear on a number line.
2. maps paths between locations and compares lengths of different paths on a coordinate grid.

Possible Fifth Grade Application Indicators

The student:

1. uses coordinate grids to formulate and solve real-world problems involving distance and location.

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Standard 4: The student uses concepts and procedures of data analysis in a variety of situations.

Benchmark 1: PROBABILITY - The student uses probability to generate convincing arguments, draw conclusions, and make decisions in a variety of situations.

Seventh Grade Knowledge Base Indicators

The student:

1. determines the probability of a compound event composed of two independent events.
2. explains and gives examples of events having probability of one or zero.

Δ 3. describes probability of events using fractions, decimals and percents.
For the purpose of assessing this indicator on the Kansas Assessment the student should be able to determine the probability of a simple event or a compound event composed of two simple, independent events.

Seventh Grade Application Indicators

The student:

1. conducts experiments and/or simulations, records the results in charts, tables or graphs, and uses the results to draw conclusions and make predictions.
2. compares theoretical (expected) results with empirical (experimental) results.
3. makes predictions based on theoretical probabilities of compounded events.

Possible Sixth Grade Knowledge Base Indicators

The student:

1. lists all possible outcomes for a compound event composed of two independent events in an organized way and recognizes whether an outcome is certain, impossible, likely or unlikely.
2. describes probability of simple events using fractions.

Possible Sixth Grade Application Indicators

The student:

1. conducts experiments and/or simulations, records the results in charts, tables, or graphs, and uses the results to draw conclusions and make predictions.
2. compares what should happen (theoretical/expected results) with what did happen (experimental/empirical results) in a simple experiment.

Possible Fifth Grade Knowledge Base Indicators

The student:

1. lists all possible outcomes of a single event in a clear and organized manner.
2. recognizes simple experiments where the probabilities of all outcomes are equal.

Possible Fifth Grade Application Indicators

The student:

1. conducts experiments and/or simulations, records the results in charts, tables or graphs, and uses the results to draw conclusions and make predictions.
2. compares what should happen (theoretical/expected results) with what did happen (experimental/empirical results) in a simple experiment.

Benchmark 2: STATISTICS - The student generates, organizes, and interprets rational number and other data in a variety of situations. The student applies measures of central tendency when drawing conclusions from the data.

Seventh Grade Knowledge Base Indicators

The student:

1. organizes, displays and reads quantitative (numerical) and qualitative (non-numerical) data in a clear, organized and accurate manner including the use of correct titles, labels, and

Seventh Grade Application Indicators

The student:

Δ 1. uses data analysis to make accurate inferences, decisions/predictions, and to develop convincing arguments from data displayed in a variety of formats. (see listing of graphical

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intervals or categories. Specific formats for the display of rational number data and other types of data include:
frequency distributions.
box-and-whiskers plots.
stem-and-leaf plots.
scatterplots.
bar, line, and circle graphs.
Venn diagrams or other pictorial displays.
charts and tables.

2. explains and conducts appropriate sampling techniques for gathering data for a given situation (observation, survey, census of total population, random sampling, etc.)

Δ 3. determines the measures of central tendency (mean, median, and mode), and the range for a rational number data set containing an even or odd number of data points.

4. identifies or determines the quartiles of a data set.

5. determines and explains the advantages and disadvantages of using each measure of central tendency and the range to describe a data set.

displays)
For the purpose of assessing this indicator on the Kansas Assessment the student should be able to:
a) work with the following data displays.
frequency distributions.
box-and-whiskers plots.
stem-and-leaf plots.
scatterplots.
bar, line, and circle graphs.
Venn diagrams or other pictorial displays.
charts and tables.
b) use any of the following statistical measures: measures of central tendency (mean, median, and mode), quartiles, and the range for a rational number data set containing an even or odd number of data points.
c) use various scales and formats to display the same data set.

2. recognizes or explains the affects of scale and/or interval changes on graphs of data sets.

3. recognizes and explains misleading representations of data.

4. recognizes faulty arguments or common errors in data analysis.

Possible Sixth Grade Knowledge Base Indicators

The student:

1. organizes, displays and reads quantitative (numerical) and qualitative (non-numerical) data in a clear, organized and accurate manner including the use of correct titles, labels, and intervals or categories. Specific formats for the displays of rational number data and other types of data include:
frequency distributions.
stem-and-leaf plots.
scatterplots.
bar, line, and circle graphs.
Venn diagrams or other pictorial displays.
charts and tables.

2. conducts and explains sampling techniques (observations, surveys, random sampling) for gathering data.

3. determines the mean, mode and range for a whole number data set.

4. determines the median for a rational number data set containing an odd number of data points.

Possible Sixth Grade Application Indicators

The student:

1. uses data analysis to make accurate inferences, decisions/predictions, and to develop convincing arguments from data displayed in a variety of formats. (see listing of graphical displays)

2. recognizes or explains the affects of scale and/or interval changes on graphs of whole number data sets.

3. explains advantages and disadvantages of using various display formats for a specific data set.

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Possible Fifth Grade Knowledge Base Indicators

The student:

1. organizes, reads, and displays numerical (quantitative) and non-numerical (qualitative) data in a clear, organized, and accurate manner including correct titles, labels, and intervals or categories. Specific formats for the display of numerical and categorical data include:
   - frequency distributions.
   - stem-and-leaf plots.
   - bar, line and circle graphs
   - Venn diagrams or other pictorial displays.
   - charts and tables.
2. conducts, and explains sampling techniques (observations, surveys, random sampling) for gathering data.
3. ranks the values of a numerical data set containing simple fractions and decimals, identifies maximum and minimum data values, and calculates the range for a data set.
4. calculates and explains the mean (average) for a whole number data set.
5. calculates and explains the median for a whole number data set containing an even number of data points.
6. determines and explains the mode(s).

Possible Fifth Grade Application Indicators

The student:

1. uses data analysis to make accurate inferences, decisions/predictions, and to develop convincing arguments from data displayed in a variety of formats. (see listing of graphical displays)
2. recognizes or explains the affects of scale and/or interval changes on graphs of whole number data sets.
3. recognizes that the same data set can be displayed in a variety of formats and discusses why a particular format may be more appropriate than another.

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Standard 1: The student uses numerical and computational concepts and procedures in a variety of situations.

Benchmark 1: NUMBER SENSE
The student demonstrates number sense for real numbers and algebraic expressions in a variety of situations.

Tenth Grade Knowledge Base Indicators

The student:

1. compares and orders real numbers or algebraic expressions, and explains the relative magnitude among them.
2. knows, explains, and uses equivalent representations for the same real number and/or algebraic expression including integers, decimals, fractions, percents, ratios, scientific notation, absolute value, and numbers with integer exponents.

Special Note: Remember, real numbers include very large numbers such as one trillion and very small numbers such as one millionth.

Tenth Grade Application Indicators

The student:

Δ 1. uses appropriate representations of real numbers and algebraic expressions to formulate and solve real-world problems.
For the purpose of assessing this indicator on the Kansas Assessment the student should be able to use equivalent representations for the same real number and/or algebraic expression including integers, decimals, fractions, percents, ratios, scientific notation, and numbers with integer exponents.

Special Note: Remember, real numbers include very large numbers such as one trillion and very small numbers such as one-millionth.

2. determines reasonableness of solutions to problems involving real numbers and/or algebraic expression.

Possible Eighth Grade Knowledge Base Indicators

The student:

1. compares and orders real numbers or algebraic expressions and explains the relative magnitude among them.
2. knows, explains, and uses equivalent representations for the same real numbers, including integers, decimals, ratios, fractions, percents, scientific notation, and numbers with integer exponents.
3. determines the absolute value of real numbers.

Special Note: Remember, real numbers include very large numbers such as one trillion and very small numbers such as one-millionth.

Possible Eighth Grade Application Indicators

The student:

1. uses appropriate representations of real numbers and algebraic expressions to formulate and solve real-world problems.
2. determines reasonableness or magnitude of real number results.

Δ This indicator will be assessed at the state level.
N The use of calculators, abacuses or computers will not be allowed during the assessment of this indicator at the state level.
Indicators are not listed in priority order, nor are they considered as all inclusive.

Benchmark 2: NUMBER SYSTEMS AND THEIR PROPERTIES - The student demonstrates an understanding of the real number system, recognizes, applies, and explains its properties, and extends these properties to algebraic expressions.

Tenth Grade Knowledge Base Indicators

The student:

1. recognizes the need for numbers beyond the reals.
2. names, uses, and explains the following properties: addition and multiplication properties of equalities and inequalities; commutative, associative, distributive, and substitution properties; identity and inverse properties of addition and multiplication; the zero product property (if ab=0, then a=0 or b=0); and names, uses, and explains transitive, reflexive, and symmetric properties.

Tenth Grade Application Indicators

The student:

1. uses properties of the real number system to formulate and solve real-world problems.
2. uses real number properties to perform various computational procedures and explains how they are used.

Possible Eighth Grade Knowledge Base Indicators

The student:

1. recognizes the need for real numbers.
2. explains and illustrates the relationship among natural (counting) numbers, whole numbers, integers, rational numbers and irrational numbers (number lines, Venn diagrams).
3. names, uses, and explains the following properties: addition and multiplication properties of equalities and inequalities; commutative, associative, distributive, and substitution properties; identity and inverse properties of addition and multiplication; the zero product property (ab=0, then a=0 or b=0); and names, uses, and explains transitive, reflexive, and symmetric properties.

Possible Eighth Grade Application Indicators

The student:

1. uses properties of the real number system to explain reasoning, and to formulate and solve real-world problems.
2. uses real number properties to perform various computational procedures and explains how they were used.

Benchmark 3: ESTIMATION - The student uses numerical estimation with real numbers in a variety of situations.

Tenth Grade Knowledge Base Indicators

The student:

1. uses a variety of computational methods including mental mathematics, paper and pencil, concrete materials, and technological tools such as calculators or computers to estimate real number quantities.
2. estimates quantities using real numbers and/or algebraic expressions and explains the estimation method used such as rounding, special numbers, clustering, truncation, compatible numbers or simulations.

Tenth Grade Application Indicators

The student:

Δ 1. uses estimation to check reasonableness of results, and makes predictions in situations involving real numbers and algebraic expressions.
For the purpose of assessing this indicator on the Kansas Assessment the student should be able to use estimation methods such as rounding, special numbers, clustering, truncation, compatible numbers or simulations.

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2. adjusts original rational number estimates based on additional information (estimation from a frame of reference).
3. explains the impact of rounding errors on numerical results.
4. determines if a problem situation calls for an exact or approximate answer and performs the appropriate computation.

Possible Eighth Grade Knowledge Base Indicators

The student:

1. uses a variety of computational methods including mental mathematics, paper and pencil, concrete materials, and technological tools such as calculators or computers to estimate real number quantities.
2. estimates quantities using real numbers and simple algebraic expressions, explains the estimation method used such as rounding, special numbers, clustering, truncation, or compatible numbers.
3. knows and explains between which two consecutive integers an irrational number lies.
4. knows and explains why a decimal representation of an irrational number is an approximate value.

Possible Eighth Grade Application Indicators

The student:

1. uses estimation to check reasonableness of results, and makes predictions in situations involving real numbers and simple algebraic expressions.
2. adjusts original rational number estimates based on additional information (estimation from a frame of reference).
3. explains the impact of estimation on results.
4. determines if a problem situation calls for an exact or approximate answer and performs the appropriate computation.

Benchmark 4: COMPUTATION - The student explains and performs computation with real numbers and algebraic expressions in a variety of situations.

Tenth Grade Knowledge Base Indicators

The student:

1. uses a variety of computational methods including mental arithmetic (doubles and neighbors), paper and pencil, concrete materials, and technological tools such as calculators and computers.
2. explains and performs arithmetic operations and their inverses on real numbers and algebraic expressions (addition, subtraction, multiplication, division, finding roots, powers).

   The student should be able to perform the following computations:
   - manipulation of variable quantities within an equation or inequality fluently and accurately.
   - simplification of radical expressions including square roots of perfect square monomials, and cube roots of perfect cubic monomials.
   - simplification or evaluation of real numbers

Tenth Grade Application Indicators

The student:

Δ 1. uses arithmetic operations and inverse relationships to formulate and solve real-world problems involving real numbers and algebraic expressions with special emphasis on topics such as:
   - finding the volume and surface area when formulas are given.
   - applications from business, economics, chemistry, and physics (avoiding logarithms).
   - probabilities and exponential growth and decay.

   For the purpose of assessing this indicator on the Kansas Assessment the student will be expected to perform the following computations or manipulations of variable quantities fluently and accurately:
   - *simplification of radical expressions including square roots of perfect square monomials, and cube roots of perfect cubic monomials.*

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and algebraic monomial expressions raised to a power and algebraic binomial expressions raised to a power of no more than three.

simplification of the products and quotients of real number and algebraic monomial expressions using the properties of exponents.

finds prime factors, greatest common factor, multiples, and the least common multiple of algebraic expressions and real numbers.

matrix addition, multiplication, and scalar multiplication.

NΔ 3. explains and performs computational procedures emphasizing the order of operations without using a calculator.

simplification or evaluation of real numbers and algebraic monomial expressions raised to a power and algebraic binomial expressions raised to a power of no more than three.

simplification of the products and quotients of real number and algebraic monomial expressions using the properties of exponents.

finds prime factors, greatest common factor, multiples, and the least common multiple of algebraic expressions and real numbers.

determines percent of increase and decrease.

finds what percent one number is of another number.

finds a number when a percent of the number is given.

Possible Eighth Grade Knowledge Base Indicators

The student:

1. uses a variety of computational methods including mental arithmetic (doubles and neighbors), paper and pencil, concrete materials, or technological tools such as calculators or computers.
2. knows, explains and performs arithmetic operations and their inverses on real numbers (addition, subtraction, multiplication, division, square roots of perfect squares, cube roots of perfect cubes, and powers).
3. explains and performs computations using the correct order of operations.
4. finds roots of real numbers using calculators.
5. knows, explains and uses the inverse relationship between whole number exponents and their roots ($2^3=8$ and cube root of 8=2).
6. adds algebraic expressions.
7. knows, explains and performs computations involving percent of increase and decrease.
8. finds what percent one number is of another number such as what percent of 80 is 120?
9. finds a number when a percent of the number is given such as 15% of what number is 30?

Possible Eighth Grade Application Indicators

The student:

1. uses arithmetic operations and inverse relationships to formulate and solve real-world problems involving real numbers and algebraic expressions with special emphasis on topics such as percent increase and decrease.

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Standard 2: The student uses algebraic concepts and procedures in a variety of situations.

Benchmark 1: PATTERNS - The student recognizes, describes, extends, develops, analyzes and gives the general rule of patterns from a variety of situations involving tenth grade content.

Tenth Grade Knowledge Base Indicators

The student:

1. identifies and continues patterns presented in a variety of formats: numeric, algebraic, visual, oral, written, kinesthetic, pictorial, tabular, graphical, or listing.
2. recognizes patterns with two or more simultaneous changes.
3. creates and explains a pattern.

A partial list of patterns to help students meet these indicators includes:

algebraic patterns including consecutive number patterns or equations of functions such as n, n+1, n+2, ..., or f(x)=2x-1.

geometric patterns.

arithmetic or geometric sequences, as well as, classifying sequences as arithmetic or geometric and finding particular terms of arithmetic or geometric sequences (not necessarily by formula).

exponential patterns such as growth and decay.

conceptual foundations of limits such as 1/2, 1/3, 1/4, ... approaches zero.

cyclical patterns such as those on a path of a Ferris wheel and on the path of a pendulum.

combinatorics patterns such as Pascal's triangle and Fibonacci sequence.

factorials such as 7!.

Tenth Grade Application Indicators

The student:

Δ 1. recognizes the generalization of a pattern using symbolic notation to represent the n^{th} term in an explicit form.

For the purpose of assessing this indicator on the Kansas Assessment the student should be able to work with the following types of patterns:

algebraic patterns including consecutive number patterns or equations of functions such as n, n+1, n+2, ..., or f(x)=2x-1.

geometric patterns.

arithmetic or geometric sequences, as well as, classifying sequences as arithmetic or geometric and finding particular terms of arithmetic or geometric sequences (not necessarily by formula).

2. recognizes the generalization of a pattern using symbolic notation to represent the n^{th} term in a recursive form.
3. recognizes the same general pattern presented in different representations.
4. generalizes a pattern using a written description.

Possible Eighth Grade Knowledge Base Indicators

The student:

1. identifies and continues patterns presented in a variety of formats: numeric, algebraic, visual, oral, written, kinesthetic, pictorial, tabular, graphical, or listing.
2. recognizes patterns with two simultaneous changes.
3. creates a pattern.

A partial list of patterns to help students meet these indicators could include:

real number patterns such as $\pi/4$, $\pi/2$, $3\pi/4$, π...

basic algebraic patterns in one variable such as

Possible Eighth Grade Application Indicators

The student:

1. generalizes a pattern using a written description.
2. generalizes a pattern expressed in a recursive nature.
3. generalizes numerical and geometric patterns using algebra, and relates the equation, graph and table of values resulting from the generalization.
4. recognizes the same general pattern presented in different representations.

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x, 2-x, 3-x, 4-x, ... or x, x^2, x^3, ...
cyclic patterns such as time, calendars, and tides.
given a table of linear values, graph the ordered pairs and generalize the pattern.

Benchmark 2: VARIABLES, EQUATIONS, AND INEQUALITIES - The student uses variables, symbols, real numbers, and algebraic expressions to solve equations and inequalities in a variety of situations.

Tenth Grade Knowledge Base Indicators

The student:

1. explains or applies the concept of multiple variables.
2. knows and explains the use of variables as parameters for a specific variable situation such as the m and b in y = mx+b or the h, k and r in $(x-h)^2 + (y-k)^2 = r^2$.

NΔ 3. sets up and solves equations and inequalities.
For the purpose of assessing this indicator on the Kansas Assessment the student should be able to set up or solve the following:
linear equations and inequalities both analytically and graphically without the aid of a calculator or computer.
quadratic equations with rational solutions (factorable quadratic equations).
systems of linear equations with two unknowns.
radical equations involving no more than one inverse operation around the radical expression.
solves rational equations such as:

$$\frac{3}{(x+2)} = \frac{5}{(x-3)}$$

exponential equations containing the same base such as $3^x=3^5$ without the aid of a calculator or computer.
equations and inequalities involving absolute value quantities containing one variable (could be solved using a number line and the concept of absolute value).
percentage problems which include finding a number when a percent of the number is given, finding what percent one number is of another number, and finding percent increase and percent decrease

Although not assessed on the Kansas Assessment, the student:
sets up and solves systems of linear inequalities in two unknowns.

Tenth Grade Application Indicators

The student:

Δ 1. uses symbols, variables, expressions, inequalities, equations and simple systems of linear equations to represent problem situations which involve variable quantities.

Δ 2. formulates and solves problems involving symbols, percents, variables, expressions, inequalities, equations, and simple systems.
For the purpose of assessing this indicator on the Kansas Assessment the student should be able to set up and/or solve the following:
linear equations and inequalities both analytically and graphically.
quadratic equations with rational solutions (factorable quadratic equations).
systems of linear equations with two unknowns.
radical equations involving no more than one inverse operation around the radical expression.
solves rational equations such as:

$$\frac{3}{(x+2)} = \frac{5}{(x-3)}.$$

equations and inequalities involving absolute value quantities containing one variable (could be solved using a number line and the concept of absolute value).
percentage problems which include finding a number when a percent of a number is given, finding what percent one number is of another number, and finding percent increase and percent decrease.

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sets up and solves quadratic equations with real roots.
uses spreadsheets to replicate formulas and make predictions.

Possible Eighth Grade Knowledge Base Indicators

The student:

1. solves linear equations and inequalities in one variable with whole number coefficients and constants with rational number solutions analytically, graphically, and intuitively such as $2x+1=9$ or $2x+13<8$.
2. finds the number when a percent and a number are given, finds what percent one number is of another number, and finds percent increase and percent decrease.
3. evaluates formulas using substitution.
4. identifies the dependent and independent variables within a given situation.

Possible Eighth Grade Application Indicators

The student:

1. uses symbols, variables, expressions, inequalities, equations and simple systems of equations to represent problem situations which involve variable quantities.
2. formulates and solves problem situations involving percents, variables, expressions, linear equations and inequalities.

Benchmark 3: FUNCTIONS - The student analyzes functions in a variety situations.

Tenth Grade Knowledge Base Indicators

The student:

1. uses a variety of methods including mental mathematics, paper and pencil, concrete materials, and graphing utilities or other technological tools to evaluate and analyze functions.
2. explains or uses function notation.
3. evaluates function(s) given a specific domain.
4. explains the difference between and identifies independent and dependent variables.
5. recognizes, identifies, or matches the graphs of the following functions: linear, quadratic, absolute value, and constant functions.
6. recognizes, identifies or matches equations to the graphs of the following functions: cubic, $1/x$, exponential, step, and greatest integer functions.
7. evaluates $f(x)$ including piecewise functions.
8. determines whether a graph, a list of ordered pairs, a table of values, or function rule represents a function.
9. determines whether a function is continuous or not by observing its graph.
10. determines intercepts, maximum or minimum values by observing its graph.
11. determines intercept(s), maximum, or minimum function values of quadratic functions given the rule of the function in an equation format.

Tenth Grade Application Indicators

The student:

1. moves between symbolic, numerical, and graphical representations of functions with fluency and accuracy.
2. analyzes the effects of parameter changes on the appearance of a function's graph such as scale changes or restricted domains.
3. analyzes how changes in constants and/or slopes within a linear function affect the appearance of a graph.
4. analyzes how changes in constants and/or coefficients within quadratic and absolute value functions affect the appearance of the graph.

Δ 5. interprets the meaning of points on a graph in the context of a real world situation.
For Kansas Assessment purposes the student should be able to make contextual interpretations involving the x and y intercepts, the slope, points on and off the line, and a line of best fit.

6. examines a situation and extracts from it quantities that vary directly and indirectly and represents that variation in a graph, in a table, or in an equation.

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12. identifies domain and range including the concept of infinity.
13. evaluates the composition of two functions at a given value such as $f(x)=x^2$, $g(x)=x+3$, find $f(g(3))$.

NΔ 14. recognizes how changes in constants and/or slope within a linear function changes the appearance of a graph

Possible Eighth Grade Knowledge Base Indicators

The student:

1. knows and explains the difference between linear and nonlinear relationships.

Possible Eighth Grade Application Indicators

The student:

1. moves between symbolic, numerical, tabular and graphical representations of linear relationships with fluency and accuracy.
2. uses variables to generalize patterns, and information presented in tables, charts, and graphs.

Benchmark 4: MODELS - The student develops and uses models to represent and justify mathematical relationships found in a variety of situations involving tenth grade knowledge and skills.

Tenth Grade Knowledge Base Indicators

The student:

1. uses mathematical models to represent and explain mathematical concepts and procedures.
2. creates mathematical models to show the relationship between two or more things.

The student knows, explains, and uses these specific models:

the number line to model the relationship between real numbers and operations on real numbers.

the coordinate plane to model ordered pairs, linear and quadratic functions, and two-dimensional functions including the graphs of rectangles, triangles and circles.

equations and inequalities to model numerical and/or geometric relationships.

diagrams or pictures to represent problem situations.

frequency distributions, box-and-whiskers plots, stem-and-leaf plots, histograms, scatterplots, bar graphs, line graphs, circle graphs, Venn diagrams, charts, tables, and matrices to organize and display data.

algebraic expressions to model relationships between two successive numbers in a sequence or other numerical patterns.

three-dimensional solids to model surface area, volume, and conic sections, geoboard and

Tenth Grade Application Indicators

The student:

Δ 1. uses the mathematical modeling process to make inferences about real world situations.
For the purpose of assessing this indicator on the Kansas Assessment the student should be able to work with the following types of models:

the number line to model the relationship between real numbers and operations on real numbers.

the coordinate plane to model ordered pairs, linear and quadratic functions, and two-dimensional functions including the graphs of rectangles, triangles and circles.

equations and inequalities to model numerical relationships.

equations and inequalities to model geometric relationships.

diagrams or pictures to represent problem situations.

two- or three-dimensional models to model surface area and volume.

Special Note: The mathematical modeling process involves:

a) selecting key features and relationships within the real world situation and representing these concepts in mathematical terms through some sort of

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dot paper to model area, perimeter, and isometric views of three-dimensional figures.
geometric models to represent algebraic relationships and operations such as modeling factoring and completing the square through area models.
cyclical pattern models such as the clock and pendulum to model cycles such as the sine and cosine curves.
Pascal's Triangle to model binomial expansion and probability.
tessellations to model patterns, area, and transformations.
constructions to model geometric theorems and properties.
area models to reinforce geometric probability.
trees to model probability and prime factorization and paths to model networking.

Possible Eighth Grade Knowledge Base Indicators

The student:

1. uses mathematical models to represent and explain mathematical concepts and procedures.
2. creates mathematical models to show the relationship between two or more things.

The student knows, explains, and uses these specific mathematical models:
draws a diagram/picture to model a problem situation.
the number line to model the relationship between real numbers and operations on real numbers.
the coordinate plane to model ordered pairs and linear equations and inequalities.
equations and inequalities to model numerical relationships.
graphs, tables or charts to organize, interpret and analyze data.

Possible Eighth Grade Application Indicators

The student:

1. recognizes the same situation can be modeled in more than one way.
2. determines if a given graphical, algebraic or geometric model is an accurate representation of a specific real-world situation.
3. uses the mathematical modeling process to make inferences about real-world situations.

Special Note: The mathematical modeling process involves:

a) selecting key features and relationships within the real-world situation and representing these concepts in mathematical terms through some sort of mathematical model;
b) performing manipulations and mathematical procedures within the mathematical model;
c) interpreting the results of the manipulations within the mathematical model and using these results to make inferences about the original real-world situation.

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Standard 3: The student uses geometric concepts and procedures in a variety of situations.

Benchmark 1: GEOMETRIC FIGURES AND THEIR PROPERTIES - The student recognizes geometric figures, and applies, compares, and justifies the properties of geometric figures in a variety of situations.

Tenth Grade Knowledge Base Indicators

The student:

1. uses appropriate technology, manipulatives, constructions or drawings to recognize, compare and explain properties of geometric figures.
2. recognizes, classifies and discusses properties of all geometric figures listed in previous grade level indicators plus the following figures: any two-dimensional figure including parabolas and sectors of circles.
3. recognizes, classifies and discusses properties of ellipses, hyperbolas, secant lines, and tangent lines, and intersections of two-dimensional figures and three-dimensional figures with each other.
4. recognizes, explains and compares parallel line properties including angle relationships created by a transversal.
5. recognizes, explains and compares the following properties: congruence properties of triangles such as SSS, ASA, SAS, AAS, and HL; angle relationships of triangles, ratios in special right triangles such as 30-60-90 and 45-45-90; and central and inscribed angles.
6. applies the Pythagorean theorem to determine if a triangle is a right triangle or to find a missing side of a right triangle.
7. recognizes and applies properties of corresponding parts of congruent and similar figures to find missing sides.
8. explains or uses symbols for congruence, similarity, arc, and circle.

Tenth Grade Application Indicators

The student:

1. uses definitions, axioms, theorems and deductive reasoning to justify the following:
   a) parallel line properties including angle relationships created by a transversal.
   b) angle relationships in triangles such as the base angles of an isosceles triangle are equal or the sum of the angles in a triangle equals 180 degrees.

Δ 2. formulates and solves real-world problems by applying properties of geometric figures.
For the purpose of assessing this indicator on the Kansas Assessment the student is expected to be able to:
a) recognize, explain and compare parallel line properties including angle relationships created by a transversal.
b)apply the Pythagorean theorem to determine if a triangle is a right triangle or to find a missing side of a right triangle.
c) recognize and apply properties of corresponding parts of congruent and similar figures to find missing sides.
d) apply angle and side properties of squares, rectangles, triangles, trapezoids, and parallelograms such as: the opposite sides of a parallelogram are equal and parallel; a right triangle has one angle which is 90°; or the sum of the angles of a triangle equals 180°.
e) use symbols and definitions for perpendicular, parallel, triangle, and right angle.
f) determine the radius or diameter of a circle.

3. uses definitions, axioms, theorems and deductive reasoning to justify the following properties of geometric figures:
   a) congruence properties of triangles (SSS, ASA, AAS, and HL)
   b) ratios in special right triangles.
   c) central and inscribed angles.
4. understands the concepts of and develops both formal and informal proof through understanding of the difference between a

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statement verified by mathematical proof (i.e. theorem) and a statement verified by using examples.

Possible Eighth Grade Knowledge Base Indicators

The student:

1. recognizes, classifies and discusses properties of all geometric figures listed in previous grade level indicators plus the following figures: point, line, plane.
2. knows angle relationships formed by parallel lines cut by a transversal using appropriate technology (alternate interior, alternate exterior, supplementary, vertical angles, corresponding angles, complementary, consecutive interior).
3. recognizes and discusses the symmetry that exists in three-dimensional figures.
4. recognizes the following figures and explains their attributes: arc, chord, and semicircle.
5. knows and explains how to use appropriate technology, manipulatives, constructions, or drawings to recognize, classify and compare geometric figures.
6. recognizes or applies properties of corresponding parts of similar and congruent triangles and quadrilaterals.

Possible Eighth Grade Application Indicators

The student:

1. formulates and solves real-world problems by applying properties of geometric figures.
2. knows, explains, and uses triangle inequality properties to determine if a triangle exists.

Benchmark 2: MEASUREMENT AND ESTIMATION - The student estimates, measures and uses geometric formulas in a variety of situations.

Tenth Grade Knowledge Base Indicators

The student:

1. uses various estimation techniques to determine real number approximations of length, volume, surface area, area, perimeter, weight, capacity, temperature, distance, time and angle measurement.
2. states, recognizes or applies formulas for area and perimeter for triangles, rectangles, and squares, the circumference and area of circles, volume of rectangular solids, and distance on a number line.
3. applies various measurement formulas to two- and three-dimensional figures (regular and irregular) including volume, surface area, area, perimeter, and distance when given the formula.
4. applies various measurement techniques to find accurate real number representations for length, volume, capacity, surface area, area, distance, weight, mass, temperature, distance,

Tenth Grade Application Indicators

The student:

Δ 1. formulates and solves real-world problems by applying measurements and measurement formulas.

For the purpose of assessing this indicator on the Kansas Assessment the student is expected to be able to:

a) state, recognize or apply formulas for areas and perimeters of triangles, rectangles, and squares, the circumference and areas of circles, volume of rectangular solids, and distance on the number line.

b) apply various measurement formulas to two- and three-dimensional figures (regular and irregular) including volume, surface area, area, and distance when given the formula.

c) apply the Pythagorean theorem to determine if a triangle is a right triangle or to find a missing side of a right triangle.

d) perform conversions within the standard or

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midpoint, time, and angle measurements with the appropriate formula provided.
5. explains how simple measurement formulas involving circles, parallelograms, trapezoids, cubes, and cylinders are derived.
6. selects, explains the selection and uses measurement tools, units of measure, and degrees of accuracy appropriate to the given situation.
7. knows, explains, and uses quotients of two different measures to describe rates of change.
8. approximates conversions between the standard and metric measurement systems given the conversion units or formulas.
9. recognizes and applies properties of corresponding parts of congruent and similar figures to find measurements of missing sides.

metric measurement system.

2. uses estimation to check reasonableness of measurements and calculations and/or adjusts original measurements based on additional information (estimation from a frame of reference).
3. uses indirect measurements to measure inaccessible objects.

Possible Eighth Grade Knowledge Base Indicators

The student:

1. uses various estimation techniques to determine rational number approximations of surface area, weight, and capacity.
2. uses given measurement formulas for two- and three-dimensional figures including area of a trapezoid, volume of a cylinder and triangular prism, and surface area of a cylinder and triangular prism.
3. applies various measurement techniques, uses appropriate tools; units of measure and degree of accuracy to find accurate real number representations for length, volume, surface area, area, perimeter, weight, capacity, temperature, time and angle measurements.
4. explains how simple measurement formulas involving squares, rectangles, and triangles work.
5. uses ratios and proportions to measure inaccessible objects.
6. performs conversions within each system of measurement.

Possible Eighth Grade Application Indicators

The students:

1. formulates and solves real-world problems by applying measurements and measurement formulas.
2. uses estimation to check reasonableness of measurements and calculations and/or adjusts original measurements based on additional information (estimation from a frame of reference).

Benchmark 3: TRANSFORMATIONAL GEOMETRY - The student recognizes and applies transformation of two- and three-dimensional figures in a variety situations.

Tenth Grade Knowledge Base Indicators

The student:

1. recognizes and describes single and multiple transformations [(rotation in ninety degree intervals, reflection, translation, shrink or magnify (dilate)] to two- and three-dimensional figures.

Tenth Grade Application Indicators

The student:

1. uses a variety of scales to view and analyze two- and three-dimensional figures.
2. uses visualization and spatial reasoning to represent, formulate and solve real-world problems.

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2. explains and performs single and multiple transformations [rotation, reflection, translation, shrink or magnify (dilate)] on two- and three-dimensional figures.
3. recognizes and describes the three-dimensional figure created by rotating a two-dimensional shape around a fixed line.
4. determines the actual dimensions/measurements or shape of a three-dimensional model from a two-dimensional drawing.
5. creates a two-dimensional scale drawing of a three-dimensional shape.

3. represents geometric transformations using sketches, coordinate systems, vectors, or matrices.

Δ 4. analyzes the impact of transformations on area and perimeter of triangles and circles and on volume of cylinders and rectangular prisms. *For the purpose of assessing this indicator on the Kansas Assessment the student should be able to recognize and describe simple and multiple transformations (rotations in ninety degree intervals, reflection, translation shrink or magnify [dilate]) to two- and three-dimensional figures.*

5. analyzes the impact of transformations on geometric figures within the coordinate plane.
6. describes and draws three-dimensional shapes as they would appear after undergoing two specified transformations without actually performing the transformations with concrete objects.

Possible Eighth Grade Knowledge Base Indicators

The student:

1. recognizes, explains, and performs single and multiple transformations [rotation, reflection, translation, shrink or magnify (dilate)] to two-dimensional figures.
2. performs reflections of two-dimensional figures in the coordinate plane, over the x- and y-axis.
3. creates a scale drawing of a two-dimensional shape.
4. draws three-dimensional shapes as they would appear from a variety of visual perspectives (top, bottom, side, and corner).
5. creates a two-dimensional drawing of a three-dimensional shape.

Possible Eighth Grade Application Indicators

The student:

1. explains the impact of transformations on the volume of a cube and area of a parallelogram.
2. uses transformations to examine symmetrical properties of geometric figures.
3. discusses and discerns relationships among combinations of reflections, translations and rotations.
4. describes and draws two-dimensional shapes as they would appear after undergoing two specified transformations and three-dimensional shapes as they would appear after undergoing one specified transformation without actually performing the transformation(s) with concrete objects.

Benchmark 4: GEOMETRY FROM AN ALGEBRAIC PERSPECTIVE - The student uses an algebraic perspective to analyze the geometry of two- and three-dimensions in a variety of situations.

Tenth Grade Knowledge Base Indicators

The student:

1. uses a variety of methods including mental mathematics, paper and pencil, concrete materials, and graphing utilities and other technological tools to recognize and examine the geometry of two- and three-dimensional figures.
2. determines if a given point lies on the graph of

Tenth Grade Application Indicators

The student:

1. analyzes how changes in constants and/or coefficients within the equation of a line or parabola changes the appearance of the graph of the equation.
2. translates between the algebraic representation of a problem and the geometric representation of a problem.

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a given line or parabola without graphing, and justifies his/her answer.

Δ 3. calculates the slope of a line from a list of ordered pairs on the line and explains how the graph of the line is related to its slope.

Δ 4. finds or explains the relationship between the slopes of perpendicular and parallel lines.

5. uses the distance formula, slopes, and/or the Pythagorean theorem to find the missing side of any right triangle or to determine if a triangle is a right triangle when the triangle is presented on the coordinate plane.

NΔ 6. recognizes an equation of a line in any form and transforms the equation into slope-intercept form in order to identify characteristics such as slope and the y-intercept and uses this form to graph the line.

7. recognizes an equation of a parabola in any form and identifies characteristics of the parabola such as the vertex, the maximum or minimum value, the line of symmetry, and the direction of the concavity, and sketches a graph of the parabola.

8. explains the relationship between the solution(s) to systems of equations and/or inequalities in two unknowns and their graphs (linear programming).

9. solves problems involving rate as a measure of change such as velocity or acceleration.

3. represents, formulates and solves distance and geometry problems using the language and symbols of algebra and the coordinate plane.

4. recognizes and explains the affects of scale changes on the appearance of the graph of an equation or inequality involving a line or parabola.

Possible Eighth Grade Knowledge Base Indicators

The student:

1. uses a variety of methods including mental mathematics, paper and pencil, concrete materials, graphing utilities and other technological tools to analyze two-dimensional geometry on the coordinate plane.
2. creates a T-table from a linear equation and plots ordered pairs.
3. lists five coordinate pairs on the graph of a line and states the pattern that exists.
4. determines the length of a side of a figure drawn on a coordinate plane with vertices having the same x-coordinates or y-coordinates.
5. recognizes that ordered pairs that lie on the graph of an equation are solutions to that equation.
6. recognizes that points that do not lie on the graph of an equation are not solutions to that equation.

Possible Eighth Grade Application Indicators

The student:

1. represents, formulates and solves distance and geometry problems using the language and symbols of algebra and the coordinate plane.

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Standard 4: The student uses concepts and procedures of data analysis in a variety of situations.

Benchmark 1: PROBABILITY - The student applies probability theory to analyze the validity of arguments, draw conclusions, and make decisions in a variety of situations.

Tenth Grade Knowledge Base Indicators

The student:

1. recognizes a distribution that is approximately normal.
2. recognizes and calculates the probabilities associated with the normal curve.
3. calculates probability involving two independent events.
4. calculates conditional probability involving two events.
5. uses permutations and combinations to determine the number of possible outcomes of an event.

Δ 6. explains the relationship between probability and odds, and computes one given the other.

Tenth Grade Application Indicators

The student:

Δ 1. uses theoretical or experimental probability to make predictions about real-world events such as work in economics, quality control, genetics, meteorology and other areas of science, games, and situations involving geometric probability.
For the purpose of assessing this indicator on the Kansas Assessment the student should be able to use geometric probability, percentages derived from actual or simulated events, and determine the probability of a simple event or a compound event composed of two or more simple, independent events.

2. conducts experiments and/or simulations, records the results in charts, tables or graphs, and uses the results to draw conclusions and make predictions.
3. compares theoretical (expected) results with empirical (experimental) results.
4. uses conditional probabilities to make decisions.

Possible Eighth Grade Knowledge Base Indicators

The student:

1. knows and explains the difference between independent and dependent events.
2. identifies situations involving independent or dependent events.
3. calculates the odds of a desired outcome in a simple experiment.

Possible Eighth Grade Application Indicators

The student:

1. conducts experiments and/or simulations, records the results in charts, tables or graphs, and uses the results to draw conclusions and make predictions.
2. compares theoretical (expected) results with empirical (experimental) results.

Benchmark 2: STATISTICS - The student generates, organizes, and interprets real number and other data in a variety of situations.

Tenth Grade Knowledge Base Indicators

The student:

1. organizes, displays and reads quantitative (numerical) and qualitative (non-numerical) data in a clear, organized and accurate manner including the use of correct titles, labels, and intervals or categories. Specific formats for data displays include:
   frequency distributions.
   box-and-whiskers plots.

Tenth Grade Application Indicators

The student:

1. determines or explains appropriate sampling techniques for gathering data for a given situation (observation, survey, census of total population, random sampling, sampling of specific groups, etc.).

Δ 2. uses data analysis to make accurate inferences, decisions/predictions, and to develop convincing arguments from data displayed in a

Δ This indicator will be assessed at the state level.
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stem-and-leaf plots.
histograms.
scatterplots or other discrete graphs.
bar, line, and circle graphs.
Venn diagrams or other pictorial displays.
charts and tables.

2. calculates and explains the measures of dispersion (standard deviation and range) for a real number data set given the appropriate formulas.
3. calculates and explains the meaning of quartiles, percentiles, and interquartile range for a real number data set.
4. explains the affects of outliers on the measures of central tendency and measures of dispersion of a real number data set.
5. approximates a line of best fit given a scatter plot, and makes predictions using the equation of that line.
6. calculates and explains the variance for a real data set given the appropriate formula.
7. explains how the reader's bias, measurement errors, and display distortion can affect the interpretation of data.

variety of formats. (see listing of graphical displays)
For the purpose of assessing this indicator on the Kansas Assessment the student should be able to:
a) use any of the following data displays:
frequency distributions.
box-and-whiskers plots.
stem-and-leaf plots.
histograms.
scatterplots or other discrete graphs.
bar, line, and circle graphs.
Venn diagrams or other pictorial displays.
charts and tables.
b) use any of the following statistical measures - measures of central tendency (mean, median, mode), the range, quartiles, and interquartile range.
c) explain the affects of outliers on the mean, median, and range of a real number data set.
d) approximate a line of best fit given a scatter plot, and make predictions.using the equation of that line.

Δ 3. recognizes or explains the affects of scale and/or interval changes on graphs of data sets.
For the purpose of assessing this indicator on the Kansas Assessment the student should be able to use any of the following data displays:
frequency distributions.
box-and-whiskers plots.
stem-and-leaf plots.
histograms.
scatterplots or other discrete graphs.
bar, line, and circle graphs.
Venn diagrams or other pictorial displays.
charts and tables.

4. determines the advantages and disadvantages of using various statistical measures to describe a data set.
5. analyzes the affects of data transformations on various statistical measures.
6. uses properties of the normal curve to make inferences about data sets that are assumed to be normally distributed.

Possible Eighth Grade Knowledge Base Indicators

The student:

1. organizes, displays and reads quantitative (numerical) and qualitative (non-numerical) data in a clear, organized and accurate manner

Possible Eighth Grade Application Indicators

The student:

1. explains advantages and disadvantages of various sampling techniques for gathering data for a given situation (observation, survey,

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including the use of correct titles, labels, and intervals or categories. Specific formats for data displays include:

- frequency distributions.
- box-and-whiskers plots.
- stem-and-leaf plots.
- histograms.
- scatterplots.
- bar, line, and circle graphs.
- Venn diagrams or other pictorial displays.
- charts and tables.

2. calculates and explains the measures of central tendency (mean, median, mode) for a real number data set.
3. calculates or explains the range, quartiles, and interquartile range for a real number data set.
4. makes a scatterplot and draws a line that approximately represents the data.
5. explains the affects of outliers on the mean, median, and range of a real number data set.
6. recognizes valid and invalid sampling techniques.

census of total population, random sampling, etc.)

2. uses data analysis to make accurate inferences, decisions/predictions, and to develop convincing arguments from data displayed in a variety of formats. (see listing of graphical displays)
3. uses changes in scales, intervals or categories to help support a particular interpretation of the data.

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Kansas

Curricular Standards for Mathematics

by

Standard and Benchmark

Standard: The student uses numerical and computational concepts and procedures in a variety of situations.

Tenth Grade Benchmark: *The student demonstrates number sense for real numbers and algebraic expressions in a variety of situations.*

Tenth Grade Indicators

Knowledge Base

The student:

1. compares and orders real numbers or algebraic expressions, and explains the relative magnitude among them.
2. knows, explains, and uses equivalent representations for the same real number and/or algebraic expression including integers, decimals, fractions, percents, ratios, scientific notation, absolute value, and numbers with integer exponents.

   Special Note: Remember, real numbers include very large numbers such as one trillion and very small numbers such as one millionth.

Application

The student:

Δ 1. uses appropriate representations of real numbers and algebraic expressions to formulate and solve real-world problems.
For the purpose of assessing this indicator on the Kansas Assessment the student should be able to use equivalent representations for the same real number and/or algebraic expression including integers, decimals, fractions, percents, ratios, scientific notation, and numbers with integer exponents.

Special Note: Remember, real numbers include very large numbers such as one trillion and very small numbers such as one-millionth.

2. determines reasonableness of solutions to problems involving real numbers and/or algebraic expression.

Possible Eighth Grade Indicators

Knowledge Base

The student:

1. compares and orders real numbers or algebraic expressions and explains the relative magnitude among them.
2. knows, explains, and uses equivalent representations for the same real numbers, including integers, decimals, ratios, fractions, percents, scientific notation, and numbers with integer exponents.
3. determines the absolute value of real numbers.

   Special Note: Remember, real numbers include very large numbers such as one trillion and very small numbers such as one-millionth.

Application

The student:

1. uses appropriate representations of real numbers and algebraic expressions to formulate and solve real-world problems.
2. determines reasonableness or magnitude of real number results.

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Indicators are not listed in priority order, nor are they considered as all inclusive.

Standard: The student uses numerical and computational concepts and procedures in a variety of situations.

Seventh Grade Benchmark: The student demonstrates number sense for rational numbers, pi, and simple algebraic expressions in one variable in a variety of situations.

Seventh Grade Indicators

Knowledge Base

The student:

1. compares and orders rational numbers and pi, and explains the relative magnitude among them.

Special Note: Remember, rational numbers include large numbers such as one million and small numbers such as one thousandth.

2. knows, explains, and uses equivalent representations for rational numbers: integers, decimals, fractions, percents, ratios, numbers with whole number exponents, and scientific notation.
3. explains and determines the absolute value of rational numbers.
4. knows, explains, and uses equivalent representations for the same simple algebraic expressions such as $2x + 5x$ could be written as $7x$.

NΔ 5. knows and explains what happens to the product or quotient when a number is multiplied or divided by a number between zero and one or a number greater than one.

Application

The student:

Δ 1. uses appropriate representations of rational numbers, pi, and simple algebraic expressions to formulate and solve real-world problems. *For the purpose of assessing this indicator on the Kansas Assessment the student should be able to use equivalent representations for rational numbers: integers, decimals, fractions, percents, ratios, numbers with whole number exponents, and scientific notation.*

Special Note: Remember, rational numbers include large numbers such as one million and small numbers such as one-thousandth.

2. determines reasonableness of solutions to problems involving rational numbers, pi and simple algebraic expressions.

Possible Sixth Grade Indicators

Knowledge Base

The student:

1. compares and orders decimals and fractions greater than zero and integers, and explains the relative magnitude among them.
2. knows, explains, and uses equivalent representations for fractions and decimals.
3. knows and explains relationships between percents and ratios.
4. knows, explains, and uses whole number exponents.
5. uses equivalent representations for the same simple algebraic expression such as $x+x+x$ could be written as $3x$.

Application

The student:

1. uses appropriate representations of positive rational numbers to formulate and solve real-world problems.
2. determines reasonableness of solutions to problems involving rational numbers greater than or equal to zero.

Δ This indicator will be assessed at the state level.
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Indicators are not listed in priority order, nor are they considered as all inclusive.

Standard: The student uses numerical and computational concepts and procedures in a variety of situations.

Seventh Grade Benchmark: *The student demonstrates number sense for rational numbers, pi, and simple algebraic expressions in one variable in a variety of situations.*

Possible Fifth Grade Indicators

Knowledge Base

The student:

1. compares and orders whole numbers, decimals and fractions greater than zero, and explains the relative magnitude among them.
2. identifies integers and gives real-world situations where integers are used.
3. uses equivalent representations for the same whole number, decimals, and simple fractions (thirds, halves, fourths, tenths and hundredths).

Application

The student:

1. uses appropriate representations of whole numbers, decimals and fractions to formulate and solve real-world problems.
2. determines reasonableness of solutions to problems involving whole numbers, decimals and fractions greater than or equal to zero.

Fourth Grade Benchmark: *The student demonstrates number sense for whole numbers, simple fractions, money, and decimals in a variety of situations.*

Fourth Grade Indicators

Knowledge Base

The student:

1. compares and orders whole numbers to 1,000,000, simple fractions (halves, fourths, eighths, sixteenths, thirds, tenths, hundredths), mixed numbers and decimals to the thousandths place.

NΔ 2. knows, explains, and uses addition, subtraction, multiplication, and division and other equivalent representations for whole numbers, decimals, time, and money, and addition, subtraction, and pictorial representations for simple fractions such as 12÷2=4+2 or 7¢=$.07=7/100 of a dollar.

Application

The student:

1. uses appropriate representations of whole numbers to formulate and solve real-world problems.

NΔ 2. determines reasonableness of numerical values involving whole numbers to 1,000,000, simple fractions, and decimals to the thousandths.

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Indicators are not listed in priority order, nor are they considered as all inclusive.

Standard: The student uses numerical and computational concepts and procedures in a variety of situations.

Fourth Grade Benchmark: *The student demonstrates number sense for whole numbers, simple fractions, money, and decimals in a variety of situations.*

Possible Third Grade Indicators

Knowledge Base

The student:

1. compares and orders whole numbers to 100,000 and fractions with like denominators involving sixteenths, twelfths, eighths, fourths, thirds, halves, tenths, and hundredths using concrete materials.
2. knows, explains, and uses addition, subtraction, and multiplication to show equivalent representations for whole numbers such as 3x2=4+2.
3. knows, explains, and represents whole numbers to 100,000; decimals to tenths and hundredths; simple fractions; money (making change, mixed coinage for any amount, and money exchanges).

Application

The student:

1. uses appropriate representations of whole numbers to formulate and solve real-world problems.
2. determines reasonableness of numerical values involving whole numbers, simple fractions, and decimals when used as monetary amounts.

Second Grade Benchmark: *The student demonstrates number sense for three-digit whole numbers and simple fractions in a variety of situations.*

Second Grade Indicators

Knowledge Base

The student:

1. compares and orders whole numbers to 1,000 and simple fractions (fourths, thirds, and halves) using concrete materials.
2. knows, explains, and represents whole numbers to 1,000.
3. uses addition and subtraction facts to show equivalent representations for whole numbers such as 8-5=2+1 or 20+40=70-10.
4. identifies coins, states their values, and determines the total value (to $1.00) of a mixed group of coins using pennies, nickels, dimes, quarters, or half-dollars.
5. counts like combinations of the following bills: $1, $5, $10, and $20.
6. identifies and uses ordinal positions.

Application

The student:

1. uses appropriate representations of whole numbers to formulate and solve real-world problems.
2. determines reasonableness of numerical values involving whole numbers to 1,000, simple fractions, and money using decimals up to hundredths.

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Indicators are not listed in priority order, nor are they considered as all inclusive.

Standard: **The student uses numerical and computational concepts and procedures in a variety of situations.**

Second Grade Benchmark: *The student demonstrates number sense for three-digit whole numbers and simple fractions in a variety of situations.*

Possible First Grade Indicators

Knowledge Base

The student:

1. compares and orders whole numbers up to 100 and fourths and halves with concrete materials.
2. knows, explains, and represents whole numbers to 100 using concrete materials.
3. identifies and states the value of the following coins: pennies, nickels, dimes, and quarters; and the following bills: $1, $5, $10, and $20.
4. recognizes and counts a like group of coins consisting of pennies, nickels, and dimes.
5. identifies and uses ordinal positions up to tenth.
6. uses pictures or models to recognize and represent equal parts of a whole.

Application

The student:

1. uses appropriate representations of whole numbers to formulate and solve real-world problems.
2. determines reasonableness of numerical results involving whole numbers to 100.

Possible Kindergarten Indicators

Knowledge Base

The student:

1. compares and orders whole numbers to 20.
2. recognizes a whole, half, and parts of a whole.
3. establishes a one-to-one correspondence to 20 items and identifies, states or writes the appropriate cardinal number.
4. identifies and states the values of pennies and dimes.
5. identifies positions as first and last.

Application

The student:

1. uses numbers and concrete items to twenty to formulate and solve real-world problems.

Δ This indicator will be assessed at the state level.
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Indicators are not listed in priority order, nor are they considered as all inclusive.

Standard: **The student uses numerical and computational concepts and procedures in a variety of situations.**

Tenth Grade Benchmark: *The student demonstrates an understanding of the real numbe. system, recognizes, applies, and explains its properties, and extends these properties to algebraic expressions.*

Tenth Grade Indicators

Knowledge Base

The student:

1. recognizes the need for numbers beyond the reals.
2. names, uses, and explains the following properties: addition and multiplication properties of equalities and inequalities; commutative, associative, distributive, and substitution properties; identity and inverse properties of addition and multiplication; the zero product property (if ab=0, then a=0 or b=0); and names, uses, and explains transitive, reflexive, and symmetric properties.

Application

The student:

1. uses properties of the real number system to formulate and solve real-world problems.
2. uses real number properties to perform various computational procedures and explains how they are used.

Possible Eighth Grade Indicators

Knowledge Base

The student:

1. recognizes the need for real numbers.
2. explains and illustrates the relationship among natural (counting) numbers, whole numbers, integers, rational numbers and irrational numbers (number lines, Venn diagrams).
3. names, uses, and explains the following properties: addition and multiplication properties of equalities and inequalities; commutative, associative, distributive, and substitution properties; identity and inverse properties of addition and multiplication; the zero product property (ab=0, then a=0 or b=0); and names, uses, and explains transitive, reflexive, and symmetric properties.

Application

The student:

1. uses properties of the real number system to explain reasoning, and to formulate and solve real-world problems.
2. uses real number properties to perform various computational procedures and explains how they were used.

A This indicator will be assessed at the state level.
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Indicators are not listed in priority order, nor are they considered as all inclusive.

Standard: The student uses numerical and computational concepts and procedures in a variety of situations.

Seventh Grade Benchmark: *The student demonstrates an understanding of the rational number system and pi, recognizes, applies, and explains its properties, and extends these properties to algebraic expressions in one variable.*

Seventh Grade Indicators

Knowledge Base

The student:

1. recognizes the need for rational numbers and pi.
2. classifies rational numbers as members of various number systems.
3. knows or explains the relationships among natural (counting) numbers, whole numbers, integers, and rational numbers (models include number lines, Venn diagrams).
4. knows the correct terminology for, explains, and uses: addition and multiplication properties of equality; commutative, associative, distributive, and substitution properties, additive and multiplicative identity properties; additive and multiplicative inverse properties; multiplicative property of zero; transitive, reflexive and symmetric properties; transitive property of inequality; and the addition property of inequality.

Application

The student:

Δ 1. uses properties of the rational number system and pi to explain reasoning, and to formulate and solve real-world problems.
For the purpose of assessing this indicator on the Kansas Assessment the student should be able to use any of the following properties: addition and multiplication properties of equality; commutative, associative, distributive, and substitution properties, additive and multiplicative identity properties; additive and multiplicative inverse properties; multiplicative property of zero; transitive, reflexive and symmetric properties; transitive property of inequality; and the addition property of inequality.

2. uses rational number properties to perform various computational procedures and explains how they were used.

Possible Sixth Grade Indicators

Knowledge Base

The student:

1. recognizes the need for integers.
2. understands that counting numbers, whole numbers, fractions, mixed numbers, and decimals are rational numbers.
3. identifies and explains prime and composite numbers.
4. uses the following properties: commutative and associative properties for addition and multiplication; the distributive property; additive and multiplicative identities; additive inverse; multiplicative property of equality; additive property of equality; and the reflexive, transitive, and symmetric properties of equalities.

Application

The student:

1. uses properties of the rational number system to explain reasoning and to formulate and solve real-world problems.
2. uses rational number properties to perform various computational procedures and explains how they were used.

Δ This indicator will be assessed at the state level.
N The use of calculators, abacuses or computers will not be allowed during the assessment of this indicator at the state level.
Indicators are not listed in priority order, nor are they considered as all inclusive.

Standard: **The student uses numerical and computational concepts and procedures in a variety of situations.**

Seventh Grade Benchmark: *The student demonstrates an understanding of the rational number system and pi, recognizes, applies, and explains its properties, and extends these properties to algebraic expressions in one variable.*

Possible Fifth Grade Indicators

Knowledge Base

The student:

1. recognizes the need for decimals and fractions.
2. classifies various types of numbers as whole numbers, mixed numbers, fractions, and decimals.
3. recognizes Roman Numerals that are used for dates, on clock faces, and in outlines.
4. identifies prime and composite numbers to 50.
5. uses the following properties: commutative and associative properties for addition and multiplication; the substitution property; additive and multiplicative identity properties; and the symmetric property of equality.

Application

The student:

1. uses properties of the rational number system to explain their reasoning, formulate and solve real-world problems.
2. uses rational number properties to perform various computational procedures and explains how they were used.

A This indicator will be assessed at the state level.
N The use of calculators, abacuses or computers will not be allowed during the assessment of this indicator at the state level.
Indicators are not listed in priority order, nor are they considered as all inclusive.

Standard: The student uses numerical and computational concepts and procedures in a variety of situations.

Fourth Grade Benchmark: *The student demonstrates an understanding of whole numbers with a special emphasis on place value, recognizes, uses, and explains their properties, and extends these properties to simple fractions, mixed numbers, decimals and money.*

Fourth Grade Indicators

Knowledge Base

The student:

1. recognizes the need for whole numbers, simple fractions, mixed numbers, and decimals to thousandths.
2. classifies various types of numbers as whole numbers, mixed numbers, or fractions and decimals; identifies the place value of various digits from thousandths up to millions.
3. identifies, models, writes, and reads numbers using numerals, words, and expanded form from thousandths to millions such as four million sixty-two thousand two hundred eighty-four = 4,062,284 = 4x1,000,000 + 6x10,000 + 2x1,000 + 2x100 + 8x10 + 4x1.

NΔ 4. uses the concepts of the following whole number properties: commutative property of addition and multiplication; associative properties of addition and multiplication such as 4+(2+3)=(4+2)+3 or 2x(3x4)=(2x3)x4, additive and multiplicative identity properties (zero property of addition and multiplicative property of one); the distributive property; the symmetric property of addition and multiplication such as 100=20+80 is the same as 20+80=100; and the multiplicative property of zero with two factors such as 9x0=0 or 112x0=0.

5. identifies odd and even numbers.

Application

The student:

NΔ 1. uses place value and properties of the whole number system and money to explain his/her reasoning, and to formulate and solve real-world problems.
For the purpose of assessing this indicator on the Kansas Assessment the student should be able to:
a) use place value from thousandths up to millions.
b) use concepts of the following whole number properties: commutative property of addition and multiplication; associative properties of addition and multiplication such as 4+(2+3)=(4+2)+3 or 2x(3x4)=(2x3)x4, additive and multiplicative identity properties (zero property of addition and multiplicative property of one); the distributive property; the symmetric property of addition and multiplication such as 100=20+80 is the same as 20+80=100; and the multiplicative property of zero with two factors such as 9x0=0 or 112x0=0.

2. uses place value and whole number properties to perform various computational procedures, extends these properties to simple fractions, mixed numbers and decimals and explains how the properties are used.

Δ This indicator will be assessed at the state level.
N The use of calculators, abacuses or computers will not be allowed during the assessment of this indicator at the state level.
Indicators are not listed in priority order, nor are they considered as all inclusive.

Standard: The student uses numerical and computational concepts and procedures in a variety of situations.

Fourth Grade Benchmark: *The student demonstrates an understanding of whole numbers with a special emphasis on place value, recognizes, uses, and explains their properties, and extends these properties to simple fractions, mixed numbers, decimals and money.*

Possible Third Grade Indicators

Knowledge Base

The student:

1. recognizes the need for whole numbers, simple fractions, and decimals (tenths and hundredths).
2. classifies various types of numbers as whole numbers, mixed numbers, fractions, and decimals.
3. identifies the place value of various digits from hundredths to one-hundred thousands.
4. identifies, models, writes, and reads numbers using numerals, words, and expanded form from hundredths to one hundred thousands such as sixty-four thousand three hundred eighty = 64,380 = 6x10,000 + 4x1,000 + 3x100 + 8x10 + 0x1.
5. uses the concepts of the following whole number properties: commutative property of addition and multiplication; additive and multiplicative identity properties (zero property of addition and multiplicative property of one); the distributive property; the symmetric property of addition and multiplication such as 100=20+80 is the same as 20+80=100; and the multiplicative property of zero with two factors such as 9x0=0 or 112x0=0.
6. identifies odd and even whole numbers to 1000.

Application

The student:

1. uses properties of the whole number system and money to explain reasoning, and to formulate and solve real-world problems.
2. uses and explains whole number properties to perform various computational procedures.

Δ This indicator will be assessed at the state level.
N The use of calculators, abacuses or computers will not be allowed during the assessment of this indicator at the state level.
Indicators are not listed in priority order, nor are they considered as all inclusive.

Standard: The student uses numerical and computational concepts and procedures in a variety of situations.

Second Grade Benchmark: *The student demonstrates an understanding of simple fractions (fourths, thirds, halves) and three-digit whole numbers with a special emphasis on place value, and recognizes, applies, and explains their properties.*

Second Grade Indicators

Knowledge Base

The student:

1. identifies the place value of various digits in whole numbers to 1,000.
2. counts subsets of numbers from 1 to 1,000 forwards and backwards such as 311, 312. 313,..., 317; 210, 209, 208, ..., 204.
3. reads or writes whole numbers to 1,000 in numeric form and whole numbers from zero to 100 in words, such as 76 can be written as seventy-six.
4. uses concepts of the following whole number properties and demonstrates their meaning with concrete materials:
   a) the commutative property of addition such as 3+2=2+3.
   b) the associative property of addition such as (3+2)+4=3+(2+4).
   c) the additive identity property (zero property of addition) such as 4+0=4.
   d) the symmetric property applied to basic addition and subtraction facts such as 10=2+8 is the same as 2+8=10 or 7=10-3 is the same as 10-3=7.
5. identifies odd and even whole numbers to 100.

Application

The student:

1. uses properties of the whole number system and money to explain reasoning, and to formulate and solve real-world problems.
2. uses whole number properties to perform various computational procedures.

Possible First Grade Indicators

Knowledge Base

The student:

1. identifies the place value of various digits in whole numbers to 100.
2. counts subsets of numbers from 1 to 100 both forwards and backwards.
3. reads and writes whole numbers to 100 in numeric form and whole numbers from zero to ten in words.
4. identifies odd and even whole numbers to 50.

Application

The student:

1. uses properties of the whole number system and money to explain reasoning, and to formulate and solve real-world problems.
2. uses whole number properties to perform various computational procedures.

Δ This indicator will be assessed at the state level.
N The use of calculators, abacuses or computers will not be allowed during the assessment of this indicator at the state level.
Indicators are not listed in priority order, nor are they considered as all inclusive.

Standard: The student uses numerical and computational concepts and procedures in a variety of situations.

Second Grade Benchmark: *The student demonstrates an understanding of simple fractions (fourths, thirds, halves) and three-digit whole numbers with a special emphasis on place value, and recognizes, applies, and explains their properties.*

Possible Kindergarten Indicators

Knowledge Base

The student:

1. groups objects into tens.
2. counts subsets of numbers from 1 to 20.
3. counts backwards from 10.
4. reads and writes whole numbers to 20 in numeric form

Application

The student:

1. uses properties of the whole number system and money to explain reasoning, and to formulate and solve real-world problems.
2. uses whole number properties to perform various computational procedures.

A This indicator will be assessed at the state level.
N The use of calculators, abacuses or computers will not be allowed during the assessment of this indicator at the state level.
Indicators are not listed in priority order, nor are they considered as all inclusive.

Standard: The student uses numerical and computational concepts and procedures in a variety of situations.

Tenth Grade Benchmark: *The student uses numerical estimation with real numbers in a variety of situations.*

Tenth Grade Indicators

Knowledge Base

The student:

1. uses a variety of computational methods including mental mathematics, paper and pencil, concrete materials, and technological tools such as calculators or computers to estimate real number quantities.
2. estimates quantities using real numbers and/or algebraic expressions and explains the estimation method used such as rounding, special numbers, clustering, truncation, compatible numbers or simulations.

Application

The student:

Δ 1. uses estimation to check reasonableness of results, and makes predictions in situations involving real numbers and algebraic expressions.
For the purpose of assessing this indicator on the Kansas Assessment the student should be able to use estimation methods such as rounding, special numbers, clustering, truncation, compatible numbers or simulations.

2. adjusts original rational number estimates based on additional information (estimation from a frame of reference).
3. explains the impact of rounding errors on numerical results.
4. determines if a problem situation calls for an exact or approximate answer and performs the appropriate computation.

Possible Eighth Grade Indicators

Knowledge Base

The student:

1. uses a variety of computational methods including mental mathematics, paper and pencil, concrete materials, and technological tools such as calculators or computers to estimate real number quantities.
2. estimates quantities using real numbers and simple algebraic expressions, explains the estimation method used such as rounding, special numbers, clustering, truncation, or compatible numbers.
3. knows and explains between which two consecutive integers an irrational number lies.
4. knows and explains why a decimal representation of an irrational number is an approximate value.

Application

The student:

1. uses estimation to check reasonableness of results, and makes predictions in situations involving real numbers and simple algebraic expressions.
2. adjusts original rational number estimates based on additional information (estimation from a frame of reference).
3. explains the impact of estimation on results.
4. determines if a problem situation calls for an exact or approximate answer and performs the appropriate computation.

Δ This indicator will be assessed at the state level.
N The use of calculators, abacuses or computers will not be allowed during the assessment of this indicator at the state level.
Indicators are not listed in priority order, nor are they considered as all inclusive.

Standard: The student uses numerical and computational concepts and procedures in a variety of situations.

Seventh Grade Benchmark: The student uses numerical estimation with rational numbers and pi in a variety of situations.

Seventh Grade Indicators

Knowledge Base

The student:

1. uses a variety of computational methods including mental mathematics, paper and pencil, concrete materials, or technological tools such as calculators and computers to estimate quantities involving rational numbers and pi.
2. estimates quantities involving rational numbers and pi using various estimation techniques such as rounding, special numbers, clustering, truncation, and compatible numbers.
3. recognizes and explains the difference between exact and approximate values of rational numbers and pi.
4. discusses the appropriateness of the estimation strategy used and its impact on the result.

Application

The student:

Δ 1. uses estimation to check reasonableness of results, and makes predictions in situations involving rational numbers, pi and simple algebraic expressions.
For the purpose of assessing this indicator on the Kansas Assessment the student should be able to estimate quantities involving rational numbers and pi using various estimation techniques such as rounding, special numbers, clustering, truncation, and compatible numbers.

2. adjusts original rational number estimates based on additional information (estimation from a frame of reference).

Δ 3. determines if a problem situation calls for an exact or approximate answer and performs the appropriate computation with rational numbers and pi. *See benchmark 4 for computation expectations.*

Possible Sixth Grade Indicators

Knowledge Base

The student:

1. uses a variety of computational methods including mental mathematics, paper and pencil, concrete materials, and technological tools such as calculators and computers to estimate quantities involving rational numbers.
2. estimates quantities involving rational numbers using various estimation techniques such as rounding, special numbers, clustering, truncation or compatible numbers.
3. recognizes and explains the difference between exact and approximate values.
4. explains the estimation strategy implemented and its impact on the result.

Application

The student:

1. uses estimation to check reasonableness of results, and makes predictions in situations involving rational numbers and pi.
2. adjusts original rational number estimates based on additional information (estimation from a frame of reference).
3. determines if a problem situation calls for an exact or approximate answer and performs the appropriate computation.

Δ This indicator will be assessed at the state level.
N The use of calculators, abacuses or computers will not be allowed during the assessment of this indicator at the state level.
Indicators are not listed in priority order, nor are they considered as all inclusive.

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Standard: The student uses numerical and computational concepts and procedures in a variety of situations.

Seventh Grade Benchmark: The student uses numerical estimation with rational numbers and pi in a variety of situations.

Possible Fifth Grade Indicators

Knowledge Base

The student:

1. uses a variety of computational methods including mental mathematics, paper and pencil, concrete materials and technological tools such as calculators and computers to estimate quantities involving whole numbers, fractions including mixed numbers, decimals and money.
2. uses various estimation techniques such as front-end with adjustment, rounding, special numbers, clustering, and compatible numbers to estimate quantities involving whole numbers, fractions including mixed numbers, decimals and money.
3. recognizes and explains the difference between exact and approximate values.
4. explains the estimation strategy implemented and its possible impact on the result.

Application

The student:

1. uses estimation to check reasonableness of results, and makes predictions in situations involving whole numbers, fractions including mixed numbers, decimals and money.
2. adjusts original rational number estimates based on additional information (estimation from a frame of reference).
3. determines if a problem situation calls for an exact or approximate answer and performs the appropriate computation.

Δ This indicator will be assessed at the state level.
N The use of calculators, abacuses or computers will not be allowed during the assessment of this indicator at the state level.
Indicators are not listed in priority order, nor are they considered as all inclusive.

Standard: The student uses numerical and computational concepts and procedures in a variety of situations.

Fourth Grade Benchmark: *The student uses numerical estimation with whole numbers, simple fractions, decimals, and money in a variety of situations.*

Fourth Grade Indicators

Knowledge Base

The student:

1. uses a variety of computational methods including mental mathematics, paper and pencil, concrete materials, and technological tools such as calculators and computers to estimate quantities involving whole numbers, simple fractions (halves, thirds, fourths) decimals (.1, .01, .001) and money.
2. explains and uses various estimation techniques, such as: front-end with adjustment, rounding, special numbers, clustering, and compatible numbers to estimate quantities using whole numbers, decimals, money, and simple fractions (halves, thirds, fourths).
3. recognizes and explains the difference between exact and approximate values.

Application

The student:

1. uses estimation to check reasonableness of results, and makes predictions in situations involving whole numbers, simple fractions (halves, thirds, fourths) decimals and money.
2. adjusts original whole number estimates based on additional information (estimation from a frame of reference).

NΔ 3. determines if a problem situation calls for an exact or approximate answer and performs the appropriate computation.
For the purpose of assessing this indicator on the Kansas Assessment the student should be able to use various estimation techniques such as front-end with adjustment, rounding, special numbers, clustering, and compatible numbers to estimate quantities. See Benchmark 4 for a further explanation of computation expectations.

Possible Third Grade Indicators

Knowledge Base

The student:

1. uses a wide variety of computational methods including mental mathematics, paper and pencil, concrete materials, and technological tools such as calculators and computers to estimate quantities involving whole numbers, simple fractions (halves, thirds, and fourths), decimals (.1 or .01), and money.
2. explains and uses estimation techniques, including front-end with adjustment, and rounding to the nearest tens, hundreds, or thousand.
3. recognizes and explains the differences between exact and approximate values.

Application

The student:

1. uses estimation to check reasonableness of results, and makes predictions in situations involving whole numbers, fractions including mixed numbers, decimals and money.
2. adjusts original rational number estimates based on additional information (estimation from a frame of reference).
3. determines if a problem situation calls for an exact or approximate answer and performs the appropriate computation.
4. estimates monetary amounts needed to make purchases.

Δ This indicator will be assessed at the state level.
N The use of calculators, abacuses or computers will not be allowed during the assessment of this indicator at the state level.
Indicators are not listed in priority order, nor are they considered as all inclusive.

Standard: The student uses numerical and computational concepts and procedures in a variety of situations.

Second Grade Benchmark: The student uses numerical estimation with whole numbers up to 999, simple fractions, and money.

Second Grade Indicators

Knowledge Base

The student:

1. uses a variety of computational methods including mental mathematics, paper and pencil, concrete materials, and technological tools such as calculators and computers to estimate quantities involving whole numbers, simple fractions, and money.
2. uses various estimation techniques, including front-end with adjustment for two digit numbers, and rounding to the nearest ten, with whole numbers to 1000.

Application

The student:

1. uses estimation to check reasonableness of results and make predictions in situations involving whole numbers, simple fractions and money.
2. adjusts original whole number estimates based on additional information (estimation from a frame of reference).

Possible First Grade Indicators

Knowledge Base

The student:

1. uses concrete objects to make estimates based on a frame of reference with numbers to 100.
2. uses estimation to check reasonableness of results of numbers to 100.

Application

The student:

1. adjusts whole number estimates based on additional information (estimation from a frame of reference).
2. selects a reasonable magnitude from three given quantities, a one-digit numeral, a two-digit numeral, and a three-digit numeral (5, 50, 500), and explains the reasonableness of his/her choice for a familiar problem situation involving magnitude.

Possible Kindergarten Indicators

Knowledge Base

The student:

1. determines if one set of objects has more, less or about the same number of objects as a second set of the same kind of objects.

Application

Δ This indicator will be assessed at the state level.
N The use of calculators, abacuses or computers will not be allowed during the assessment of this indicator at the state level.
Indicators are not listed in priority order, nor are they considered as all inclusive.

Standard: The student uses numerical and computational concepts and procedures in a variety of situations.

Tenth Grade Benchmark: *The student explains and performs computation with real numbers and algebraic expressions in a variety of situations.*

Tenth Grade Indicators

Knowledge Base

The student:

1. uses a variety of computational methods including mental arithmetic (doubles and neighbors), paper and pencil, concrete materials, and technological tools such as calculators and computers.
2. explains and performs arithmetic operations and their inverses on real numbers and algebraic expressions (addition, subtraction, multiplication, division, finding roots, powers).

   The student should be able to perform the following computations:
   manipulation of variable quantities within an equation or inequality fluently and accurately.
   simplification of radical expressions including square roots of perfect square monomials, and cube roots of perfect cubic monomials.
   simplification or evaluation of real numbers and algebraic monomial expressions raised to a power and algebraic binomial expressions raised to a power of no more than three.
   simplification of the products and quotients of real number and algebraic monomial expressions using the properties of exponents.
   finds prime factors, greatest common factor, multiples, and the least common multiple of algebraic expressions and real numbers.
   matrix addition, multiplication, and scalar multiplication.

NΔ 3. explains and performs computational procedures emphasizing the order of operations without using a calculator.

Application

The student:

Δ 1. uses arithmetic operations and inverse relationships to formulate and solve real-world problems involving real numbers and algebraic expressions with special emphasis on topics such as:
finding the volume and surface area when formulas are given.
applications from business, economics, chemistry, and physics (avoiding logarithms).
probabilities and exponential growth and decay.
For the purpose of assessing this indicator on the Kansas Assessment the student will be expected to perform the following computations or manipulations of variable quantities fluently and accurately:
simplification of radical expressions including square roots of perfect square monomials, and cube roots of perfect cubic monomials..
simplification or evaluation of real numbers and algebraic monomial expressions raised to a power and algebraic binomial expressions raised to a power of no more than three.
simplification of the products and quotients of real number and algebraic monomial expressions using the properties of exponents.
finds prime factors, greatest common factor, multiples, and the least common multiple of algebraic expressions and real numbers.
determines percent of increase and decrease.
finds what percent one number is of another number.
finds a number when a percent of the number is given.

Δ This indicator will be assessed at the state level.
N The use of calculators, abacuses or computers will not be allowed during the assessment of this indicator at the state level.
Indicators are not listed in priority order, nor are they considered as all inclusive.

Standard: The student uses numerical and computational concepts and procedures in a variety of situations.

Tenth Grade Benchmark: *The student explains and performs computation with real numbers and algebraic expressions in a variety of situations.*

Possible Eighth Grade Indicators

Knowledge Base

The student:

1. uses a variety of computational methods including mental arithmetic (doubles and neighbors), paper and pencil, concrete materials, or technological tools such as calculators or computers.
2. knows, explains and performs arithmetic operations and their inverses on real numbers (addition, subtraction, multiplication, division, square roots of perfect squares, cube roots of perfect cubes, and powers).
3. explains and performs computations using the correct order of operations.
4. finds roots of real numbers using calculators.
5. knows, explains and uses the inverse relationship between whole number exponents and their roots ($2^3=8$ and cube root of 8=2).
6. adds algebraic expressions.
7. knows, explains and performs computations involving percent of increase and decrease.
8. finds what percent one number is of another number such as what percent of 80 is 120?
9. finds a number when a percent of the number is given such as 15% of what number is 30?

Application

The student:

1. uses arithmetic operations and inverse relationships to formulate and solve real-world problems involving real numbers and algebraic expressions with special emphasis on topics such as percent increase and decrease.

Δ This indicator will be assessed at the state level.
N The use of calculators, abacuses or computers will not be allowed during the assessment of this indicator at the state level.
Indicators are not listed in priority order, nor are they considered as all inclusive.

Standard: The student uses numerical and computational concepts and procedures in a variety of situations.

Seventh Grade Benchmark: *The student explains and performs computations with rational numbers, pi and first degree algebraic expressions in one variable in a variety of situations.*

Seventh Grade Indicators

Knowledge Base

The student:

1. uses a variety of computational methods including mental arithmetic (doubles and neighbors), paper and pencil, concrete materials, or technological tools such as calculators and computer.

NΔ 2. explains and performs computations with rational numbers, pi, and first degree algebraic expressions in one variable.
For the purpose of assessing this indicator on the Kansas Assessment the student should be able to perform the following computations without the aid of calculators, abacuses, or computers:
addition, subtraction, multiplication and division of rational numbers with a special emphasis on fractions.
simplification of expressions using the correct order of operations.
express answers in simplest form.
find percentages of numbers.
find roots of perfect whole number squares.
simplification and evaluation of positive rational numbers raised to positive whole number powers.

Although not assessed on the Kansas Assessment, the student also explains and performs the following computations:
combine like terms of a first degree algebraic expression in one variable.
find roots of perfect whole number cubes intuitively.

3. recognizes, explains, and uses different ways to express arithmetic operations.

4. analyzes and explains computational procedures including the use of more than one arithmetic approach to perform a computation such as 49x23 = (40x23)+(9x23) or 49x23 = (49x20) + (49x3) or 49x23 = (50x23) - 23.

Application

The student:

Δ 1. uses arithmetic operations and inverse relationships to formulate and solve real-world problems involving rational numbers, pi and first degree algebraic expressions in one variable.
For the purpose of assessing this indicator on the Kansas Assessment the student should be able to perform the following computations:
addition, subtraction, multiplication and division of rational numbers with a special emphasis on fractions.
simplification of expressions using the correct order of operations.
express answers in simplest form.
find percentages of numbers.
simplification and evaluation of positive rational numbers raised to positive whole number powers.

Δ This indicator will be assessed at the state level.
N The use of calculators, abacuses or computers will not be allowed during the assessment of this indicator at the state level.
Indicators are not listed in priority order, nor are they considered as all inclusive.

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Standard: The student uses numerical and computational concepts and procedures in a variety of situations.

Seventh Grade Benchmark: *The student explains and performs computations with rational numbers, pi and first degree algebraic expressions in one variable in a variety of situations.*

Possible Sixth Grade Indicators

Knowledge Base

The student:

1. uses a variety of computational methods including mental arithmetic (doubles and neighbors), paper and pencil, concrete materials, or technological tools such as calculators and computers.
2. explains and performs: whole number division and expresses remainders as decimals; addition, subtraction, multiplication and division with decimals; addition and subtraction with integers; and addition, subtraction, and multiplication with fractions and mixed numerals, expressing answers in simple form.
3. identifies, explains, and finds the greatest common factor and least common multiple of two or more whole numbers.
4. identifies, explains, and finds the prime factorization of whole numbers.
5. combines like terms of simple algebraic expressions.

Application

The student:

1. uses arithmetic operations and inverse relationships to formulate and solve real-world problems involving selected rational numbers.

Possible Fifth Grade Indicators

Knowledge Base

The student:

1. uses a variety of computational methods including mental arithmetic (doubles and neighbors), paper and pencil, concrete materials, or technological tools such as calculators and computers.
2. explains and performs whole number division and expresses remainders as a whole number or a fractional part; addition, subtraction and multiplication of decimals; addition and subtraction of fractions and mixed numbers without regrouping and expresses answers in simplest form.
3. finds factors and multiples of whole numbers

Application

The student:

1. uses arithmetic operations and inverse relationships to formulate and solve real-world problems involving selected rational numbers.

A This indicator will be assessed at the state level.
N The use of calculators, abacuses or computers will not be allowed during the assessment of this indicator at the state level.
Indicators are not listed in priority order, nor are they considered as all inclusive.

Standard: The student uses numerical and computational concepts and procedures in a variety of situations.

Fourth Grade Benchmark: *The student explains and performs computation with whole numbers, addition and subtraction of proper fractions with like denominators, and money in a variety of situations.*

Fourth Grade Indicators

Knowledge Base

The student:

1. uses a variety of computational methods including mental arithmetic (doubles and neighbors), paper and pencil, concrete materials, and technological tools such as calculators and computers.
2. states and uses multiplication and corresponding division facts for numbers up to twelve times twelve with efficiency and accuracy.
3. selects, explains and uses appropriate whole number operations.

NΔ 4. explains and performs computational procedures involving whole numbers, proper fractions with like denominators and money.

For the purpose of assessing this indicator on the Kansas Assessment the student should be able to perform the following computations without the aid of calculators, abacuses, or computers:

whole number addition and subtraction.

whole number multiplication up to a three-digit whole number by a two-digit whole number.

whole number division using dividends with up to three digits and a one-digit divisor.

addition and subtraction of monetary amounts using dollar and cents notation such as $47.07 + $356.96.

multiplication of whole dollar money amounts by a one - or two-digit whole number such as $45x16.

multiplication of money by whole numbers less than ten such as $14.12 x 7.

make correct change.

Although not assessed on the Kansas Assessment, the student also explains and performs the following computations:

whole number division using dividends with up to three-digits and the multiples of ten up to 100 as divisors.

division of three-digit whole dollar amounts by a one-digit whole number such as $999÷9.

addition and subtraction of proper fractions with like denominators

(continued on next page)

Application

The student:

NΔ 1. uses computational procedures to formulate and solve real-world problems involving whole numbers, proper fractions and money.

For the purpose of assessing this indicator on the Kansas Assessment the student should be able to perform the following computations without the aid of calculators, abacuses, or computers:

whole number addition and subtraction.

whole number multiplication up to a three-digit whole number by a two-digit whole number.

whole number division using dividends with up to three digits and a one-digit divisor.

addition and subtraction of monetary amounts using dollar and cents notation such as $47.07 + $356.96.

multiplication of whole dollar money amounts by a one - or two-digit whole number such as $45x16.

multiplication of money by whole numbers less than ten such as $14.12 x 7.

make correct change.

Δ This indicator will be assessed at the state level.
N The use of calculators, abacuses or computers will not be allowed during the assessment of this indicator at the state level.
Indicators are not listed in priority order, nor are they considered as all inclusive.

Standard: The student uses numerical and computational concepts and procedures in a variety of situations.

Fourth Grade Benchmark: *The student explains and performs computation with whole numbers, addition and subtraction of proper fractions with like denominators, and money in a variety of situations.*

Fourth Grade Indicators (continued)

Knowledge Base

NΔ 5. knows different ways to read and write the same addition, subtraction, multiplication or division expression such as: 6•4 is the same as 6x4 and 6 or 10 divided by 2 is the same as 10÷2 or $\frac{10}{2}$ $\underline{x4}$.

6. uses concrete materials to show the relationship between whole number addition and multiplication, and between whole numbers and multiplication and division.

7. finds multiples of whole numbers.

Application

Possible Third Grade Indicators

Knowledge Base

The student:

1. uses a wide variety of computational methods including mental arithmetic (doubles and neighbors), paper and pencil, concrete materials, and technological tools such as calculators and computers.
2. states and uses multiplication facts up through the 5's plus the 10's as well as the corresponding division facts with efficiency and accuracy.
3. explains and performs the following computational procedures:
   whole number addition and subtraction up to the one hundred thousands place.
   multiplication of a two-digit number by a one-digit number, using mathematics facts appropriate for the grade level with and without concrete materials.
   addition and subtraction of monetary amounts using dollar and cents notation such as $47.07 + $356.96.
4. explains the relationship between addition and subtraction.
5. knows different ways to read and write the same multiplication expression such as: 6 is the same as 6x4 or the same as 6•4. $\underline{x4}$.

Application

The student:

1. selects and uses computational procedures to formulate and solve real-world problems involving selected whole numbers and money.

Δ This indicator will be assessed at the state level.
N The use of calculators, abacuses or computers will not be allowed during the assessment of this indicator at the state level.
Indicators are not listed in priority order, nor are they considered as all inclusive.

Standard: The student uses numerical and computational concepts and procedures in a variety of situations.

Second Grade Benchmark: The student explains, models and performs computation with two-digit whole numbers in a variety of situations.

Second Grade Indicators

Knowledge Base

The student:

1. uses a variety of computational methods including mental arithmetic (doubles and neighbors), paper and pencil, concrete materials, and technological tools such as calculators and computers.
2. states and uses whole number addition facts with sums to 20 or less and corresponding subtraction facts with efficiency and accuracy.
3. explains and performs addition and subtraction on amounts of money to 99¢ using cent notation (25¢ + 52¢) and concrete materials.
4. explains and performs addition and subtraction with two-digit whole numbers with and without regrouping.
5. skip counts by two's, five's, or ten's to 100 and three's to 36.
6. identifies addition and subtraction fact families.
7. knows different ways to read and write the same subtraction expression such as 6-3 is the same as 6
   -3

Application

The student:

1. selects and uses addition and subtraction procedures to formulate and solve real-world problems involving whole numbers and money.

Δ This indicator will be assessed at the state level.
N The use of calculators, abacuses or computers will not be allowed during the assessment of this indicator at the state level.
Indicators are not listed in priority order, nor are they considered as all inclusive.

Standard: The student uses numerical and computational concepts and procedures in a variety of situations.

Second Grade Benchmark: *The student explains, models and performs computation with two-digit whole numbers in a variety of situations.*

Possible First Grade Indicators

Knowledge Base

The student:

1. uses a variety of computational methods including mental arithmetic (doubles and neighbors), paper and pencil, concrete materials, and technological tools such as calculators and computers.
2. states and uses basic addition facts with sums to 10 or less and their corresponding subtraction facts with efficiency and accuracy.
3. explains and performs addition and corresponding subtraction with sums to 100 using concrete objects for regrouping.
4. explains and performs addition and subtraction without regrouping to sums of 100.
5. skip counts by two's, five's, and ten's to 50.
6. uses concrete materials to show addition and subtraction are opposite operations.
7. knows different ways to read and write the same addition expression, such as: 5+4 is the same as $\begin{array}{r} 5 \\ +4 \end{array}$

Application

The student:

1. selects and uses addition and subtraction to formulate and solve real-world problems involving selected whole numbers.

Possible Kindergarten Indicators

Knowledge Base

The student:

1. performs addition and subtraction using up to 10 concrete items.

Application

The student:

1. uses addition and subtraction to formulate and solve real-world problems involving up to ten items.

A This indicator will be assessed at the state level.
N The use of calculators, abacuses or computers will not be allowed during the assessment of this indicator at the state level.
Indicators are not listed in priority order, nor are they considered as all inclusive.

Standard: The student uses algebraic concepts and procedures in a variety of situations.

Tenth Grade Benchmark: *The student recognizes, describes, extends, develops, analyzes and gives the general rule of patterns from a variety of situations involving tenth grade content.*

Tenth Grade Indicators

Knowledge Base

The student:

1. identifies and continues patterns presented in a variety of formats: numeric, algebraic, visual, oral, written, kinesthetic, pictorial, tabular, graphical, or listing.
2. recognizes patterns with two or more simultaneous changes.
3. creates and explains a pattern.

A partial list of patterns to help students meet these indicators includes:

algebraic patterns including consecutive number patterns or equations of functions such as n, n+1, n+2, ..., or f(x)=2x-1.

geometric patterns.

arithmetic or geometric sequences, as well as, classifying sequences as arithmetic or geometric and finding particular terms of arithmetic or geometric sequences (not necessarily by formula).

exponential patterns such as growth and decay.

conceptual foundations of limits such as 1/2, 1/3, 1/4, ... approaches zero.

cyclical patterns such as those on a path of a Ferris wheel and on the path of a pendulum.

combinatorics patterns such as Pascal's triangle and Fibonacci sequence.

factorials such as 7!.

Application

The student:

Δ 1. recognizes the generalization of a pattern using symbolic notation to represent the n^{th} term in an explicit form.

For the purpose of assessing this indicator on the Kansas Assessment the student should be able to work with the following types of patterns:

algebraic patterns including consecutive number patterns or equations of functions such as n, n+1, n+2, ..., or f(x)=2x-1.

geometric patterns.

arithmetic or geometric sequences, as well as, classifying sequences as arithmetic or geometric and finding particular terms of arithmetic or geometric sequences (not necessarily by formula).

2. recognizes the generalization of a pattern using symbolic notation to represent the n^{th} term in a recursive form.
3. recognizes the same general pattern presented in different representations.
4. generalizes a pattern using a written description.

Δ This indicator will be assessed at the state level.
N The use of calculators, abacuses or computers will not be allowed during the assessment of this indicator at the state level.
Indicators are not listed in priority order, nor are they considered as all inclusive.

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Standard: The student uses algebraic concepts and procedures in a variety of situations.

Tenth Grade Benchmark: *The student recognizes, describes, extends, develops, analyzes and gives the general rule of patterns from a variety of situations involving tenth grade content.*

Possible Eighth Grade Indicators

Knowledge Base

The student:

1. identifies and continues patterns presented in a variety of formats: numeric, algebraic, visual, oral, written, kinesthetic, pictorial, tabular, graphical, or listing.
2. recognizes patterns with two simultaneous changes.
3. creates a pattern.

A partial list of patterns to help students meet these indicators could include:

real number patterns such as $\pi/4$, $\pi/2$, $3\pi/4$, π...

basic algebraic patterns in one variable such as x, $2\text{-}x$, $3\text{-}x$, $4\text{-}x$, ... or x, x^2, x^3, ...

cyclic patterns such as time, calendars, and tides.

given a table of linear values, graph the ordered pairs and generalize the pattern.

Application

The student:

1. generalizes a pattern using a written description.
2. generalizes a pattern expressed in a recursive nature.
3. generalizes numerical and geometric patterns using algebra, and relates the equation, graph and table of values resulting from the generalization.
4. recognizes the same general pattern presented in different representations.

Δ This indicator will be assessed at the state level.
N The use of calculators, abacuses or computers will not be allowed during the assessment of this indicator at the state level.
Indicators are not listed in priority order, nor are they considered as all inclusive.

Standard: The student uses algebraic concepts and procedures in a variety of situations.

Seventh Grade Benchmark: The student recognizes, describes, extends, develops, and explains the general rule of patterns from a variety of situations.

Seventh Grade Indicators

Knowledge Base

The student:

NΔ 1. identifies and continues patterns presented in a variety of formats: numeric, algebraic, visual, oral, written, kinesthetic, pictorial, tabular, graphical, or listing.
For the purpose of assessing this indicator on the Kansas Assessment the student should be able to work with the following types of patterns:
rational number patterns.
patterns established by using units of measure.
patterns based on geometric shapes.
simple arithmetic and geometric sequences involving whole numbers.
patterns occurring in nature.
number patterns involving squares, cubes, and reciprocals.
numerical and geometric patterns including perfect squares, multiples, and arithmetic sequences using grade appropriate numbers.

2. recognizes patterns with two simultaneous changes.
3. creates a pattern.

Special Note: Working with various types of patterns is an important precursor to working with functions and sequences in high school.

Application

The student:

Δ 1. generalizes a pattern by using a written description.
For the purpose of assessing this indicator on the Kansas Assessment the student should be able to work with the following types of patterns:
rational number patterns.
patterns established by using units of measure.
patterns based on geometric shapes.
simple arithmetic and geometric sequences involving whole numbers.
patterns occurring in nature.
number patterns involving squares, cubes, and reciprocals.
numerical and geometric patterns including perfect squares, multiples, and arithmetic sequences using grade appropriate numbers.

2. generalizes a pattern expressed in a recursive nature.
3. recognizes the same general pattern presented in different representations.

Δ This indicator will be assessed at the state level.
N The use of calculators, abacuses or computers will not be allowed during the assessment of this indicator at the state level.
Indicators are not listed in priority order, nor are they considered as all inclusive.

Standard: The student uses algebraic concepts and procedures in a variety of situations.

Seventh Grade Benchmark: The student recognizes, describes, extends, develops, and explains the general rule of patterns from a variety of situations.

Possible Sixth Grade Indicators

Knowledge Base

The student:

1. identifies and continues patterns presented in a variety of formats: numeric, algebraic, visual, oral, written, kinesthetic, pictorial, tabular, graphical, or listing.
2. creates a pattern.
3. recognizes patterns involving simultaneous change.

A partial list of patterns to help students meet these indicators could include:

everyday life patterns appropriate for grade level across the curriculum.

numerical and geometric patterns including perfect squares, multiples, and arithmetic sequences using grade appropriate numbers.

Special Note: Working with various types of patterns is an important precursor to working with functions and sequences in high school.

Application

The student:

1. generalizes a pattern using a written description.
2. generalizes a pattern using symbolic notation when possible.
3. recognizes the same general pattern presented in different representations.

Δ This indicator will be assessed at the state level.
N The use of calculators, abacuses or computers will not be allowed during the assessment of this indicator at the state level.
Indicators are not listed in priority order, nor are they considered as all inclusive.

Standard: The student uses algebraic concepts and procedures in a variety of situations.

Seventh Grade Benchmark: The student recognizes, describes, extends, develops, and explains the general rule of patterns from a variety of situations.

Possible Fifth Grade Indicators

Knowledge Base

The student:

1. identifies, states, and continues patterns presented in a variety of formats: numeric, visual, oral, written, kinesthetic, pictorial, tabular, graphical, or listing.
2. recognizes patterns involving two changes.
3. creates a pattern.

A partial list of patterns to help students meet these indicators could include:

numerical and geometric patterns including patterns formed by powers of ten (place value) and arithmetic sequences using grade appropriate numbers such as (2, 5, 8, ...).

kinesthetic patterns.

everyday life patterns appropriate for grade level across the curriculum.

Special Note: Working with various types of patterns is an important precursor to working with functions and sequences in middle school and high school.

Application

The student:

1. generalizes a pattern using a written description.
2. recognizes the same general pattern presented in different representations.

A This indicator will be assessed at the state level.
N The use of calculators, abacuses or computers will not be allowed during the assessment of this indicator at the state level.
Indicators are not listed in priority order, nor are they considered as all inclusive.

Standard: The student uses algebraic concepts and procedures in a variety of situations.

Fourth Grade Benchmark: The student recognizes, describes, extends, develops, and explains relationships in patterns from a variety of situations.

Fourth Grade Indicators

Knowledge Base

Using concrete materials, drawings, or other representations, the student:

NΔ 1. identifies and continues patterns presented in a variety of formats: numeric, visual, oral, written, kinesthetic, pictorial, tabular, graphical, or listing.
For the purpose of assessing this indicator on the Kansas Assessment the student should be able to work with the following types of patterns:
whole number patterns both increasing and decreasing such as 20, 15, 10 . . . .
money and time patterns such as $.25, $.50, $.75 or 1:05 p.m., 1:10 p.m., 1:15 p.m.
number theory patterns, such as odds, evens, or multiples through 5's.
visual patterns involving two attributes.
measurement and geometric patterns such as 3 ft., 6 ft., 9 ft...
patterns occurring in daily life such as sports scores, longitude and latitude, elections, eras and other patterns, appropriate to grade level curriculum.
number theory patterns such as multiples and factors through 12 or multiplying by 10, 100, and 1000.
kinesthetic patterns such as clapping.

2. creates a pattern.

Special Note: Working with various types of patterns is an important precursor to working with functions and sequences in middle school and high school.

Application

The student:

1. generalizes patterns using written descriptions.

NΔ 2. recognizes the same general pattern presented in different representations such as skip counting by five's to sixty, whole number multiples of five to sixty, and the five times tables give the same numerical pattern 5, 10, 15, . . . 60.
For the purpose of assessing this indicator on the Kansas Assessment the student should be able to work with the following types of patterns:
whole number patterns both increasing and decreasing such as 20, 15, 10 . . . .
money and time patterns such as $.25, $.50, $.75 or 1:05 p.m., 1:10 p.m., 1:15 p.m.
number theory patterns, such as odds, evens, or multiples through 5's.
visual patterns involving two attributes.
measurement and geometric patterns such as 3 ft., 6 ft., 9 ft...
patterns occurring in daily life such as sports scores, longitude and latitude, elections, eras and other patterns appropriate to grade level curriculum.
number theory patterns such as multiples and factors through 12 or multiplying by 10, 100, and 1000.
kinesthetic patterns such as clapping.

Δ This indicator will be assessed at the state level.
N The use of calculators, abacuses or computers will not be allowed during the assessment of this indicator at the state level.
Indicators are not listed in priority order, nor are they considered as all inclusive.

Standard: The student uses algebraic concepts and procedures in a variety of situations.

Fourth Grade Benchmark: *The student recognizes, describes, extends, develops, and explains relationships in patterns from a variety of situations.*

Possible Third Grade Indicators

Knowledge Base

Using concrete materials, drawings, or other representations, the student:

1. identifies, states, and continues patterns presented in a variety of formats: numeric, visual, oral, written, kinesthetic, pictorial, tabular, graphical, or listing.
2. recognizes patterns involving two changes.
3. creates a pattern.

A partial list of patterns to help students meet these indicators could include:

whole number patterns both increasing and decreasing (20, 15, 10).
money and time patterns ($.25, $.50, $.75 or 1:05 p.m., 1:10 p.m., 1:15 p.m.
patterns occurring in life such as seasons, temperature or weather, appropriate for grade level topics across the curriculum.
number theory patterns, such as: odd, evens, and multiples through 5's.
kinesthetic patterns such as clapping.
visual patterns involving two attributes.

Special Note: Working with various types of patterns is an important precursor to working with functions and sequences in middle school and high school.

Application

The student:

1. generalizes patterns using written descriptions.
2. recognizes the same general pattern presented in different representations.

Δ This indicator will be assessed at the state level.
N The use of calculators, abacuses or computers will not be allowed during the assessment of this indicator at the state level.
Indicators are not listed in priority order, nor are they considered as all inclusive.

Standard: The student uses algebraic concepts and procedures in a variety of situations.

Second Grade Benchmark: *The student recognizes, describes, extends, develops, and explains relationships in patterns from a variety of situations involving second grade content.*

Second Grade Indicators

Knowledge Base

Using concrete materials, drawings, or other representations, the student:

1. identifies and continues patterns presented in a variety of formats: numeric, visual, oral, written, kinesthetic, pictorial, tabular, graphical, or listing.
2. creates a pattern.

A partial list of patterns to help students meet these indicators could include:

- whole number patterns such as 11, 22, 33 ... or 2, 4, 6.
- measurement and geometric patterns.
- calendar patterns.
- money and time patterns such as 1:45, 1:30, 1:15... or $5, $10, $15 ...
- patterns occurring in nature such as seasons, temperature, or weather.
- number theory patterns such as odds, evens, and skip counting by 3's and 4's.
- simple kinesthetic patterns such as snapping fingers, clapping, or stomping feet.
- visual patterns including shape or color.

Special Note: Working with various types of patterns is an important precursor to working with functions and sequences in middle school and high school.

Application

The student:

1. generalizes a pattern using a written description.
2. recognizes the same general pattern presented in different representations such as recognizing red, yellow, red, yellow, red, yellow . . . and 1,2,1,2,1,2 . . . are both examples of ab patterns.

Δ This indicator will be assessed at the state level.
N The use of calculators, abacuses or computers will not be allowed during the assessment of this indicator at the state level.
Indicators are not listed in priority order, nor are they considered as all inclusive.

Standard: The student uses algebraic concepts and procedures in a variety of situations.

Second Grade Benchmark: *The student recognizes, describes, extends, develops, and explains relationships in patterns from a variety of situations involving second grade content.*

Possible First Grade Indicators

Knowledge Base

Using concrete materials, drawings, or other representations, the student:

1. identifies and continues patterns presented in a variety of formats: numeric, visual, oral, kinesthetic, pictorial, tabular, graphical, or listing.
2. creates a pattern.

A partial list of patterns to help students meet these indicators could include:

whole number patterns such as 1, 2, 3, 1, 2, 3...
geometric patterns by two attributes.
money patterns such as 1¢, 2¢, 3¢, ... or 10¢, 20¢, 30¢, ...
patterns occurring in seasons and daily life such as winter, spring, summer, fall.
skip counting by 2's, 5's, and 10's.
simple kinesthetic patterns such as snapping fingers, clapping or stomping feet.
visual patterns in shape and color by large triangle, small triangle, large triangle, ... or red circle, blue circle, red circle, blue circle, ...
identify, sort, and describe groups of objects by attributes such as these dogs have spots, those do not.
identifies objects which do not belong to a particular group.

Special Note: Working with various types of patterns is an important precursor to working with functions and sequences in middle and high school.

Application

The student:

1. generalizes patterns by giving oral descriptions.
2. recognizes the same general pattern presented in different representations such as recognizing red, yellow, red, yellow, red, yellow . . . and 1,2,1,2,1,2 . . . are both examples of ab patterns.

A This indicator will be assessed at the state level.
N The use of calculators, abacuses or computers will not be allowed during the assessment of this indicator at the state level.
Indicators are not listed in priority order, nor are they considered as all inclusive.

Standard: The student uses algebraic concepts and procedures in a variety of situations.

Second Grade Benchmark: *The student recognizes, describes, extends, develops, and explains relationships in patterns from a variety of situations involving second grade content.*

Possible Kindergarten Indicators

Knowledge Base

The student:

1. identifies and continues patterns presented in a variety of formats: numeric, visual, oral, kinesthetic, pictorial, tabular, graphical, or listing.
2. creates a pattern.

A partial list of patterns to help students meet these indicators could include:
geometric patterns by one attribute.
daily life patterns such as grass is green, sky is blue.
identify and sort objects by similar traits.

Special Note: Working with various types of patterns is an important precursor to working with functions and sequences in middle school and high school.

Application

The student:

1. generalizes patterns by giving oral descriptions.
2. recognizes the same general pattern presented in different representations such as recognizing red, yellow, red, yellow, red, yellow . . . and 1,2,1,2,1,2 . . . are both examples of ab patterns.

A This indicator will be assessed at the state level.
N The use of calculators, abacuses or computers will not be allowed during the assessment of this indicator at the state level.
Indicators are not listed in priority order, nor are they considered as all inclusive.

Standard: The student uses algebraic concepts and procedures in a variety of situations.

Tenth Grade Benchmark: The student uses variables, symbols, real numbers, and algebraic expressions to solve equations and inequalities in a variety of situations.

Tenth Grade Indicators

Knowledge Base

The student:

1. explains or applies the concept of multiple variables.
2. knows and explains the use of variables as parameters for a specific variable situation such as the m and b in $y = mx+b$ or the h, k and r in $(x-h)^2 + (y-k)^2 = r^2$.

NΔ 3. sets up and solves equations and inequalities.

For the purpose of assessing this indicator on the Kansas Assessment the student should be able to set up or solve the following:

linear equations and inequalities both analytically and graphically without the aid of a calculator or computer.

quadratic equations with rational solutions (factorable quadratic equations).

systems of linear equations with two unknowns.

radical equations involving no more than one inverse operation around the radical expression.

solves rational equations such as: $\frac{3}{(x+2)} = \frac{5}{(x-3)}$

exponential equations containing the same base such as $3^x=3^5$ without the aid of a calculator or computer.

equations and inequalities involving absolute value quantities containing one variable (could be solved using a number line and the concept of absolute value).

percentage problems which include finding a number when a percent of the number is given, finding what percent one number is of another number, and finding percent increase and percent decrease.

Although not assessed on the Kansas Assessment, the student:

sets up and solves systems of linear inequalities in two unknowns.

sets up and solves quadratic equations with real roots.

uses spreadsheets to replicate formulas and make predictions.

Application

The student:

Δ 1. uses symbols, variables, expressions, inequalities, equations and simple systems of linear equations to represent problem situations which involve variable quantities.

Δ 2. formulates and solves problems involving symbols, percents, variables, expressions, inequalities, equations, and simple systems.

For the purpose of assessing this indicator on the Kansas Assessment the student should be able to set up and/or solve the following:

linear equations and inequalities both analytically and graphically.

quadratic equations with rational solutions (factorable quadratic equations).

systems of linear equations with two unknowns.

radical equations involving no more than one inverse operation around the radical expression.

solves rational equations such as: $\frac{3}{(x+2)} = \frac{5}{(x-3)}$.

equations and inequalities involving absolute value quantities containing one variable (could be solved using a number line and the concept of absolute value).

percentage problems which include finding a number when a percent of a number is given, finding what percent one number is of another number, and finding percent increase and percent decrease.

Δ This indicator will be assessed at the state level.
N The use of calculators, abacuses or computers will not be allowed during the assessment of this indicator at the state level.
Indicators are not listed in priority order, nor are they considered as all inclusive.

Standard: The student uses algebraic concepts and procedures in a variety of situations.

Tenth Grade Benchmark: The student uses variables, symbols, real numbers, and algebraic expressions to solve equations and inequalities in a variety of situations.

Possible Eighth Grade Indicators

Knowledge Base

The student:

1. solves linear equations and inequalities in one variable with whole number coefficients and constants with rational number solutions analytically, graphically, and intuitively such as $2x+1=9$ or $2x+13<8$.
2. finds the number when a percent and a number are given, finds what percent one number is of another number, and finds percent increase and percent decrease.
3. evaluates formulas using substitution.
4. identifies the dependent and independent variables within a given situation.

Application

The student:

1. uses symbols, variables, expressions, inequalities, equations and simple systems of equations to represent problem situations which involve variable quantities.
2. formulates and solves problem situations involving percents, variables, expressions, linear equations and inequalities.

Δ This indicator will be assessed at the state level.
N The use of calculators, abacuses or computers will not be allowed during the assessment of this indicator at the state level.
Indicators are not listed in priority order, nor are they considered as all inclusive.

Standard: The student uses algebraic concepts and procedures in a variety of situations.

Seventh Grade Benchmark: *The student uses variables, symbols, rational numbers, and simple algebraic expressions in one variable to solve linear equations and inequalities in a variety of situations.*

Seventh Grade Indicators

Knowledge Base

The student:

1. knows and explains that a variable can represent a single quantity that changes such as daily temperature.
2. shows and explains how changes in one variable affects other variables such as changes in diameter affects circumference
3. explains the difference between an equation and an expression.
4. explains and uses the following words and symbols to represent relationships such as $<$, $\leq$, $>$, $\geq$, $=$, $\neq$, and greater than or equal to.
5. solves two-step linear equations in one variable with whole number coefficients and constants, and positive rational solutions.
6. solves two-step linear inequalities in one variable with whole number coefficients and constants, and positive rational solutions intuitively, analytically, and graphically such as $2x + 1 > 9$.
7. solves one-step linear equations in one variable.

Δ 8. evaluates formulas using substitution.

NΔ 9. knows and explains the relationship between ratios, proportions and percents including solving for a missing term in a proportion.

10. represents solution sets of linear equations in two variables on the coordinate plane.

Application

The student:

1. uses symbols, variables, expressions, inequalities, equations and simple systems of equations to represent problem situations which involve variable or unknown quantities.

Δ 2. formulates and solves problems involving simple linear relationships, finding percents of a given number, variable situations and unknown quantities.
For the purpose of assessing this indicator on the Kansas Assessment the student should be able to solve two-step linear equations in one variable with whole number coefficients and constants, and positive rational solutions as well as two-step linear inequalities in one variable with whole number coefficients and constants, and positive rational solutions intuitively, analytically, and graphically.

Δ This indicator will be assessed at the state level.
N The use of calculators, abacuses or computers will not be allowed during the assessment of this indicator at the state level.
Indicators are not listed in priority order, nor are they considered as all inclusive

Standard: The student uses algebraic concepts and procedures in a variety of situations.

Seventh Grade Benchmark: *The student uses variables, symbols, rational numbers, and simple algebraic expressions in one variable to solve linear equations and inequalities in a variety of situations.*

Possible Sixth Grade Indicators

Knowledge Base

The student:

1. explains and uses symbols to represent unknown quantities and variable relationships.
2. solves one-step linear equations in one variable with positive whole number solutions such as $2x=8$ or $x+7=12$.
3. solves one-step whole number linear inequalities in one variable such as for what values of x is $3x > 12$.
4. finds a whole number percentage of a number such as what is 10% of 40?
5. explains and uses the relationship among ratios, proportions, and percents.

Application

The student:

1. uses symbols, variables, inequalities, and equations to represent problems involving variable situations and unknown quantities.
2. formulates and solves problems involving simple linear relationships, percents, variable situations and unknown quantities.

Possible Fifth Grade Indicators

Knowledge Base

The student:

1. explains and uses symbols to represent unknown quantities and variable relationships.
2. explains and uses the following symbols: $=, <, >, \neq, \leq, \geq$.
3. solves one-step linear equations involving one unknown.
4. solves one-step linear inequalities involving one unknown.

Application

The student:

1. uses symbols, variables, inequalities, and equations to represent problems involving variable situations and unknown quantities.
2. formulates and solves problems involving linear relationships and unknown quantities.

Δ This indicator will be assessed at the state level.
N The use of calculators, abacuses or computers will not be allowed during the assessment of this indicator at the state level.
Indicators are not listed in priority order, nor are they considered as all inclusive.

Standard: The student uses algebraic concepts and procedures in a variety of situations.

Fourth Grade Benchmark: The student uses symbols and whole numbers to solve simple equations and inequalities in a variety of situations.

Fourth Grade Indicators

Knowledge Base

The student:

1. solves one-step equations in one unknown with a whole number solution such as finding any missing number in a multiplication or division equation based on the multiplication and division facts for numbers up to 12 times 12, equations involving time and money such as 8 quarters + 10 dimes = Δ dollars or 180 minutes = Δ hours and 100 x Δ = 600.
2. reads and writes whole number equations and inequalities using correct mathematical vocabulary and notation such as 15=3x5, fifteen equals three times five; 4<6, five is greater than three, 14,564>10,000, or fourteen thousand is greater than thirteen thousand twenty-five.

Application

The student:

1. uses symbols to represent problem situations which involve unknown quantities.

NΔ 2. formulates and solves problem situations involving one-step equations in one unknown with a whole number solution. *For the purpose of assessing this indicator on the Kansas Assessment the student should be able to solve one-step equations in one unknown with a whole number solution such as finding any missing number in a multiplication or division equation based on the multiplication and division facts for numbers up to 12 times 12, equations involving time and money such as 8 quarters + 10 dimes = Δ dollars or 180 minutes = Δ hours and 100 x Δ = 600.*

Possible Third Grade Indicators

Knowledge Base

The student:

1. explains and uses symbols for unknown quantities.
2. solves equations involving only one operation up to 99.
3. finds missing multiplication facts and corresponding division facts through 5 and 10.
4. solves money equations up to a dollar.
5. compares two whole numbers between 0 and 999 using symbols (>,<, or =) and words (less than, greater than, or equal to).

Application

The student:

1. uses symbols to represent problem situations which involve unknown quantities.
2. formulates and solves problem situations involving one-step equations in one unknown with a whole number solution.

Δ This indicator will be assessed at the state level.
N The use of calculators, abacuses or computers will not be allowed during the assessment of this indicator at the state level.
Indicators are not listed in priority order, nor are they considered as all inclusive.

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Standard: The student uses algebraic concepts and procedures in a variety of situations.

Second Grade Benchmark: The student uses symbols and whole numbers up to 99 to solve addition and subtraction equations in a variety of situations.

Second Grade Indicators

Knowledge Base

The student:

1. explains or uses symbols for whole number unknown quantities.
2. solves equations involving addition or subtraction in order to find the sum or difference such as 32+19=Δ or 79-46=Δ.
3. finds missing addends and subtrahends using basic addition and subtraction facts such as 7+ Δ=12 or 12-Δ=7.
4. solves money equations involving up to two different coins such as nickel + penny = Δ ¢.
5. compares two whole numbers between 0 and 1,000 using symbols (<, >, or =) and words such as less than, greater than, or equal to.

Application

The student:

1. uses symbols to represent problem situations which involve unknown quantities.
2. formulates and solves problem situations involving addition and subtraction.

Possible First Grade Indicators

Knowledge Base

The student:

1. explains or uses symbols for whole number unknown quantities.
2. solves equations involving addition and subtraction in order to find the sums or differences such as 2+Δ = 9.
3. orally explains and compares two whole numbers between 0 and 100 using vocabulary less than, greater than, or equal to 100.

Application

The student:

1. uses concrete items, symbols, pictures or oral descriptions to represent problem situations which involve unknown quantities.
2. formulates and solves problem situations with missing sums or differences.

Possible Kindergarten Indicators

The student:

1. uses concrete materials to find missing number facts to sums of ten.

The student:

1. describes mathematical situations orally or by using concrete items and pictures.

Δ This indicator will be assessed at the state level.
N The use of calculators, abacuses or computers will not be allowed during the assessment of this indicator at the state level.
Indicators are not listed in priority order, nor are they considered as all inclusive.

Standard: The student uses algebraic concepts and procedures in a variety of situations.

Tenth Grade Benchmark: The student analyzes functions in a variety situations.

Tenth Grade Indicators

Knowledge Base

The student:

1. uses a variety of methods including mental mathematics, paper and pencil, concrete materials, and graphing utilities or other technological tools to evaluate and analyze functions.
2. explains or uses function notation.
3. evaluates function(s) given a specific domain.
4. explains the difference between and identifies independent and dependent variables.
5. recognizes, identifies, or matches the graphs of the following functions: linear, quadratic, absolute value, and constant functions.
6. recognizes, identifies or matches equations to the graphs of the following functions: cubic, 1/x, exponential, step, and greatest integer functions.
7. evaluates f(x) including piecewise functions.
8. determines whether a graph, a list of ordered pairs, a table of values, or function rule represents a function.
9. determines whether a function is continuous or not by observing its graph.
10. determines intercepts, maximum or minimum values by observing its graph.
11. determines intercept(s), maximum, or minimum function values of quadratic functions given the rule of the function in an equation format.
12. identifies domain and range including the concept of infinity.
13. evaluates the composition of two functions at a given value such as $f(x)=x^2$, $g(x)=x+3$, find $f(g(3))$.

NΔ 14. recognizes how changes in constants and/or slope within a linear function changes the appearance of a graph

Application

The student:

1. moves between symbolic, numerical, and graphical representations of functions with fluency and accuracy.
2. analyzes the effects of parameter changes on the appearance of a function's graph such as scale changes or restricted domains.
3. analyzes how changes in constants and/or slopes within a linear function affect the appearance of a graph.
4. analyzes how changes in constants and/or coefficients within quadratic and absolute value functions affect the appearance of the graph.

Δ 5. interprets the meaning of points on a graph in the context of a real world situation.
For Kansas Assessment purposes the student should be able to make contextual interpretations involving the x and y intercepts, the slope, points on and off the line, and a line of best fit.

6. examines a situation and extracts from it quantities that vary directly and indirectly and represents that variation in a graph, in a table, or in an equation.

Δ This indicator will be assessed at the state level.
N The use of calculators, abacuses or computers will not be allowed during the assessment of this indicator at the state level.
Indicators are not listed in priority order, nor are they considered as all inclusive.

Standard: The student uses algebraic concepts and procedures in a variety of situations.

Tenth Grade Benchmark: The student analyzes functions in a variety situations.

Possible Eighth Grade Indicators

Knowledge Base

The student:

1. knows and explains the difference between linear and nonlinear relationships.

Application

The student:

1. moves between symbolic, numerical, tabular and graphical representations of linear relationships with fluency and accuracy.
2. uses variables to generalize patterns, and information presented in tables, charts, and graphs.

Seventh Grade Benchmark: The student recognizes, describes, and examines constant and linear relationships in a variety situations.

Seventh Grade Indicators

Knowledge Base

The student:

1. uses a variety of methods including mental mathematics, paper and pencil, concrete materials, and graphing utilities or other technological tools to recognize and examine constant and linear relationships.
2. explains or gives examples of relationships which remain constant.
3. uses ordered pairs to demonstrate relationships.

Application

The student:

1. represents a variety of relationships using tables, graphs, verbal rules and when possible symbolic notation.

Δ 2. converts between numerical, tabular, graphical and verbal rules used to represent relationships.

Possible Sixth Grade Indicators

Knowledge Base

The student:

1. identifies or graphs ordered pairs on the coordinate plane using a variety of scales.
2. uses ratios to describe relationships.

Application

The student:

1. converts between verbal, numerical, and graphical models or concrete materials used to describe mathematical relationships

Δ This indicator will be assessed at the state level.
N The use of calculators, abacuses or computers will not be allowed during the assessment of this indicator at the state level.
Indicators are not listed in priority order, nor are they considered as all inclusive.

Standard: The student uses algebraic concepts and procedures in a variety of situations.

Seventh Grade Benchmark: The student recognizes, describes, and examines constant and linear relationships in a variety situations.

Possible Fifth Grade Indicators

Knowledge Base	Application
The student: 1. uses letters and symbols to describe whole number relationships.	The student: 1. converts between verbal, numerical, and graphical models or concrete materials used to describe mathematical relationships

Fourth Grade Benchmark: The student recognizes and describes relationships between whole numbers in a variety of situations.

Fourth Grade Indicators

Knowledge Base	Application
The student: 1. uses a variety of methods to recognize relationships between whole numbers including mental mathematics, paper and pencil, concrete materials, and graphing utilities or other technological tools. 2. uses a T-table to find ordered pairs in a relationship. NΔ 3. finds values and determines rules involving operations of whole numbers using input/output machines or T-tables. 4. identifies and graphs ordered pairs in the first quadrant.	The student: NΔ 1. uses concrete items, symbols and equations, tables, graphs, pictures and written descriptions to represent and describe mathematical relationships. 2. generalizes patterns by stating the rule using symbol notation.

Possible Third Grade Indicators

Knowledge Base	Application
The student: 1. uses a variety of methods to recognize relationships between whole numbers including mental mathematics, paper and pencil, concrete materials, and graphing utilities or other technological tools. 2. generalizes patterns by stating the rule using symbol notation. 3. identifies and graphs ordered pairs in the first quadrant. 4. finds values and determines rules involving addition and subtraction of whole numbers using input/output machines or T-tables.	The student: 1. uses concrete items, symbols and equations, tables, graphs, pictures and written descriptions to represent and describe mathematical relationships.

Δ This indicator will be assessed at the state level.
N The use of calculators, abacuses or computers will not be allowed during the assessment of this indicator at the state level.
Indicators are not listed in priority order, nor are they considered as all inclusive.

Standard: The student uses algebraic concepts and procedures in a variety of situations.

Second Grade Benchmark: The student recognizes and describes relationships between whole numbers through 99 in a variety situations.

Second Grade Indicators

Knowledge Base

The student:

1. uses a variety of methods to recognize relationships including mental mathematics, paper and pencil, and concrete materials.
2. generalizes simple numeric patterns by stating the rule using symbol notation such as for 2, 4, 6, 8, 10 . . .; the rule is □ + 2 each time.
3. uses numbers and symbols to describe whole number addition and subtraction relationships. 3+2=5, □ +2=5.
4. graphs ordered pairs on a given grid in the first quadrant.
5. finds values or determines the rule from input/out machines, T-tables or function tables which involve addition or subtraction of whole numbers.

Application

The student:

1. uses concrete items, symbols, oral descriptions or pictures to represent and describe mathematical relationships.
2. recognizes and extends numerical patterns.

Possible First Grade Indicators

Knowledge Base

The student:

1. uses a variety of methods to recognize relationships including mental mathematics, paper and pencil, and concrete materials.
2. records numerical relations in tables.
3. plots numbers up to 100 on a number line.

Application

The student:

1. uses concrete items, symbols, pictures or oral descriptions to represent and describe mathematical relationships.
2. recognizes numerical patterns.

Possible Kindergarten Indicators

Knowledge Base

The student:

1. locates numbers up to 20 on a number line.

Application

The student:

1. uses concrete items, pictures and oral descriptions to represent and describe relationships.

Δ This indicator will be assessed at the state level.
N The use of calculators, abacuses or computers will not be allowed during the assessment of this indicator at the state level.
Indicators are not listed in priority order, nor are they considered as all inclusive.

Standard: The student uses algebraic concepts and procedures in a variety of situations.

Tenth Grade Benchmark: *The student develops and uses models to represent and justify mathematical relationships found in a variety of situations involving tenth grade knowledge and skills.*

Tenth Grade Indicators

Knowledge Base

The student:

1. uses mathematical models to represent and explain mathematical concepts and procedures.
2. creates mathematical models to show the relationship between two or more things.

The student knows, explains, and uses these specific models:

the number line to model the relationship between real numbers and operations on real numbers.

the coordinate plane to model ordered pairs, linear and quadratic functions, and two-dimensional functions including the graphs of rectangles, triangles and circles.

equations and inequalities to model numerical and/or geometric relationships.

diagrams or pictures to represent problem situations.

frequency distributions, box-and-whiskers plots, stem-and-leaf plots, histograms, scatterplots, bar graphs, line graphs, circle graphs, Venn diagrams, charts, tables, and matrices to organize and display data.

algebraic expressions to model relationships between two successive numbers in a sequence or other numerical patterns.

three-dimensional solids to model surface area, volume, and conic sections, geoboard and dot paper to model area, perimeter, and isometric views of three-dimensional figures.

geometric models to represent algebraic relationships and operations such as modeling factoring and completing the square through area models.

cyclical pattern models such as the clock and pendulum to model cycles such as the sine and cosine curves.

Pascal's Triangle to model binomial expansion and probability.

tessellations to model patterns, area, and transformation.

Application

The student:

Δ 1. uses the mathematical modeling process to make inferences about real world situations.

For the purpose of assessing this indicator on the Kansas Assessment the student should be able to work with the following types of models:

the number line to model the relationship between real numbers and operations on real numbers.

the coordinate plane to model ordered pairs, linear and quadratic functions, and two-dimensional functions including the graphs of rectangles, triangles and circles.

equations and inequalities to model numerical relationships.

equations and inequalities to model geometric relationships.

diagrams or pictures to represent problem situations.

two- or three-dimensional models to model surface area and volume.

Special Note: The mathematical modeling process involves:

a) selecting key features and relationships within the real world situation and representing these concepts in mathematical terms through some sort of mathematical model;

b) performing manipulations and mathematical procedures within the mathematical model;

c) interpreting the results of the manipulations within the mathematical model and using these results to make inferences about the original real-world situation.

Δ This indicator will be assessed at the state level.
N The use of calculators, abacuses or computers will not be allowed during the assessment of this indicator at the state level.
Indicators are not listed in priority order, nor are they considered as all inclusive.

Standard: The student uses algebraic concepts and procedures in a variety of situations.

Tenth Grade Benchmark: *The student develops and uses models to represent and justify mathematical relationships found in a variety of situations involving tenth grade knowledge and skills.*

Tenth Grade Indicators (continued)

constructions to model geometric theorems and properties.
area models to reinforce geometric probability.
trees to model probability and prime factorization and paths to model networking.

Possible Eighth Grade Indicators

Knowledge Base

The student:

1. uses mathematical models to represent and explain mathematical concepts and procedures.
2. creates mathematical models to show the relationship between two or more things.

The student knows, explains, and uses these specific mathematical models:

draws a diagram/picture to model a problem situation.
the number line to model the relationship between real numbers and operations on real numbers.
the coordinate plane to model ordered pairs and linear equations and inequalities.
equations and inequalities to model numerical relationships.
graphs, tables or charts to organize, interpret and analyze data.

Application

The student:

1. recognizes the same situation can be modeled in more than one way.
2. determines if a given graphical, algebraic or geometric model is an accurate representation of a specific real-world situation.
3. uses the mathematical modeling process to make inferences about real-world situations.

Special Note: The mathematical modeling process involves:

a) selecting key features and relationships within the real-world situation and representing these concepts in mathematical terms through some sort of mathematical model;
b) performing manipulations and mathematical procedures within the mathematical model;
c) interpreting the results of the manipulations within the mathematical model and using these results to make inferences about the original real-world situation.

Δ This indicator will be assessed at the state level.
N The use of calculators, abacuses or computers will not be allowed during the assessment of this indicator at the state level.
Indicators are not listed in priority order, nor are they considered as all inclusive.

Standard: The student uses algebraic concepts and procedures in a variety of situations.

Seventh Grade Benchmark: The student develops and uses models to represent and justify mathematical relationships found in a variety of situations.

Seventh Grade Indicators

Knowledge Base

The student:

1. uses mathematical models to represent and explain mathematical concepts and procedures.

Δ 2. identifies mathematical models to show the relationship between two or more things.

For Kansas assessment purposes the student could be asked to work with the following types of models:

the number line to model the relationship between rational numbers or rational number operations.

Venn Diagrams to show the relationship between characteristics of two or more sets.

graphs, tables, and charts to organize, interpret or analyze rational number data.

scale drawings.

three-dimensional geometric models.

the coordinate plane to model ordered pairs and linear equations

diagrams, flowcharts, or pictures to represent problem situations.

Although not assessed on the Kansas assessments, additional models for the student to know, explain, and use are:

equations and inequalities to model numerical relationships between data sets.

tessellations to reinforce patterns, area, and transformations.

geometric or numerical models to reinforce probability.

concrete materials to model the relationship between decimals, percents and fractions.

manipulatives to model computation.

factor trees.

pictures and diagrams to model division of rational numbers.

Application

The student:

1. recognizes that the same situation can be represented in more than one way such as using by a table of values, a graph or an equation to represent the amount of money it would take to buy x number of CD's if CD's were $10 each.
2. explains why some models are more accurate than others in certain situations.
3. uses the mathematical modeling process to make inferences about real world situations when the mathematical model used to represent the situation is given.

Special Note: The mathematical modeling process involves:

a) selecting key features and relationships within the real world situation and representing these concepts in mathematical terms through some sort of mathematical model;

b) performing manipulations and mathematical procedures within the mathematical model;

c) interpreting the results of the manipulations within the mathematical model and using these results to make inferences about the original real-world situation.

Δ This indicator will be assessed at the state level.
N The use of calculators, abacuses or computers will not be allowed during the assessment of this indicator at the state level.
Indicators are not listed in priority order, nor are they considered as all inclusive.

Standard: The student uses algebraic concepts and procedures in a variety of situations.

Seventh Grade Benchmark: The student develops and uses models to represent and justify mathematical relationships found in a variety of situations.

Possible Sixth Grade Indicators

Knowledge Base

The student:

1. uses mathematical models to represent and explain mathematical concepts and procedures.
2. creates mathematical models to show the relationship between two or more things.

The student knows, explains, and uses mathematical models such as:

the number line to model the relationship between rational numbers and rational number operations.
Venn diagrams to show the relationships between characteristics of two or more sets.
pictorial representations of addition and subtraction of rational numbers with regrouping.
equations and inequalities to model numerical relationships.
manipulatives or pictures to model computational procedures.
three-dimensional geometric models.
graphs, tables, and charts to describe, interpret or analyze data.
diagrams or pictures to represent problem situations.

Application

The student:

1. recognizes that the same situation can be represented in more than one way.
2. explains why some models are more useful than others in certain situations.

Δ This indicator will be assessed at the state level.
N The use of calculators, abacuses or computers will not be allowed during the assessment of this indicator at the state level.
Indicators are not listed in priority order, nor are they considered as all inclusive.

Standard: The student uses algebraic concepts and procedures in a variety of situations.

Seventh Grade Benchmark: The student develops and uses models to represent and justify mathematical relationships found in a variety of situations.

Possible Fifth Grade Indicators

Knowledge Base

The student:

1. uses mathematical models to represent and explain mathematical concepts and procedures.
2. creates mathematical models to show the relationship between two or more things.

The student knows, explains, and uses mathematical models such as:

the number line to model the relationship between rational numbers and rational number operations.
Venn diagrams to show the relationships between characteristics of two or more sets.
pictorial representation of addition, subtraction of rational number with regrouping.
equations and inequalities to model numerical relationships.
manipulatives or pictures to model computational procedures.
three-dimensional geometric models.
graphs, tables, and charts to describe, interpret or analyze data.
diagrams or pictures to model problem situations.

Application

The student:

1. recognizes that the same situation can be represented in more than one way.
2. explains why some models are more useful than others in certain situations.

A This indicator will be assessed at the state level.
N The use of calculators, abacuses or computers will not be allowed during the assessment of this indicator at the state level.
Indicators are not listed in priority order, nor are they considered as all inclusive.

Standard: The student uses algebraic concepts and procedures in a variety of situations.

Fourth Grade Benchmark: The student develops and uses models to represent and justify mathematical relationships found in a variety of situations.

Fourth Grade Indicators

Knowledge Base

The student:

NΔ 1. uses mathematical models to represent and explain mathematical concepts and procedures.
For the purpose of assessing this indicator on the Kansas Assessment the student should be able to work with the following types of models:
diagrams and pictures to model problem situations.
tables, charts, and graphs to organize and display data.
place value models to compare, order and represent whole numbers.
process models for whole number operations such as multiplication arrays, division sets, the number line, and the hundreds chart.
money (coins), fraction models (fraction strips), decimal models (base ten blocks, coins) and mixed number models (pattern blocks) to compare, order or represent numerical quantities
Venn Diagrams to sort up to three attributes.
T-tables to find and show relationships between numbers.

2. creates mathematical models to show the relationship between two or more things.

Although not assessed on the Kansas Assessment, an additional model the student knows, explains, and uses simple tree diagrams for organizing attributes of sets and determining the number of possible combinations.

Application

The student:

NΔ 1. recognizes the same situation can be represented in more than one way.
For the purpose of assessing this indicator on the Kansas Assessment the student should be able to:
a) represent the number of items in a specific category for a given data set by a horizontal bar graph, a vertical bar graph, a frequency table or a written description.
b) use process models for whole number operations such as multiplication arrays, division sets, the number line, and the hundreds chart.
c) use different combinations of coins or bills to represent a monetary amount.

Special Note: The mathematical modeling process involves:
a) selecting key features and relationships within the real world situation and representing these concepts in mathematical terms through some sort of mathematical model;
b) performing manipulations and mathematical procedures within the mathematical model;
c) interpreting the results of the manipulations within the mathematical model and using these results to make inferences about the original real-world situation.

Δ This indicator will be assessed at the state level.
N The use of calculators, abacuses or computers will not be allowed during the assessment of this indicator at the state level.
Indicators are not listed in priority order, nor are they considered as all inclusive.

Standard: The student uses algebraic concepts and procedures in a variety of situations.

Fourth Grade Benchmark: The student develops and uses models to represent and justify mathematical relationships found in a variety of situations.

Possible Third Grade Indicators

Knowledge Base

The student:

1. uses mathematical models to represent and explain mathematical concepts and procedures.
2. creates mathematical models to show the relationship between two or more things.

The student knows, explains, and uses mathematical models such as:

graphs using real objects, representational objects or abstract representations to display data.
place value models to compare, order and represent whole numbers.
process models for whole number operations such as multiplication arrays, division sets, the number line, and the hundreds chart.
money (coins), fraction models (fraction strips), decimal models (base ten blocks, coins) and mixed number models (patterns blocks) to compare, order or represent numerical quantities.
tables and charts to organize data.
Venn Diagrams to sort up to two attributes.
diagrams and pictures to represent problem situations.

Application

The student:

1. recognizes the same situation can be represented in more than one way such as using a Venn diagram, a written description or a frequency table to show how the objects from a given list fall into specific categories.

Special Note: The mathematical modeling process involves:

a) selecting key features and relationships within the real world situation and representing these concepts in mathematical terms through some sort of mathematical model;
b) performing manipulations and mathematical procedures within the mathematical model;
c) interpreting the results of the manipulations within the mathematical model and using these results to make inferences about the original real-world situation.

Δ This indicator will be assessed at the state level.
N The use of calculators, abacuses or computers will not be allowed during the assessment of this indicator at the state level.
Indicators are not listed in priority order, nor are they considered as all inclusive.

Standard: The student uses algebraic concepts and procedures in a variety of situations.

Second Grade Benchmark: The student develops and uses models to represent and show mathematical relationships found in a variety of situations.

Second Grade Indicators

Knowledge Base

The student:

1. uses mathematical models to represent and explain mathematical concepts and procedures.
2. uses concrete objects, diagrams, pictures and dramatizations to show the relationship between two or more things.

The student knows, explains, and uses mathematical models such as:

graphs and tables using real objects, representational objects or abstract representations to display data.

place value models such as place value mats, hundreds charts, and base ten blocks.

process models for whole number operations such as pictures or objects representing addition and subtraction, the number line, or the hundreds chart.

Venn Diagrams to sort data using two attributes.

T-tables to find relationships between numbers.

diagrams and pictures to model situations.

Application

The student:

1. recognizes the same situation can be represented in more than one way such as using base-ten blocks, the number line or properties of whole numbers to explain a procedure for the addition of two whole numbers.

Special Note: The mathematical modeling process involves:

a) selecting key features and relationships within the real world situation and representing these concepts in mathematical terms through some sort of mathematical model;

b) performing manipulations and mathematical procedures within the mathematical model;

c) interpreting the results of the manipulations within the mathematical model and using these results to make inferences about the original real-world situation.

Δ This indicator will be assessed at the state level.
N The use of calculators, abacuses or computers will not be allowed during the assessment of this indicator at the state level.
Indicators are not listed in priority order, nor are they considered as all inclusive.

Standard: The student uses algebraic concepts and procedures in a variety of situations.

Second Grade Benchmark: The student develops and uses models to represent and show mathematical relationships found in a variety of situations.

Possible First Grade Indicators

Knowledge Base

The student:

1. uses mathematical models to represent and explain mathematical concepts and procedures.
2. uses concrete objects, diagrams, pictures and dramatizations to show the relationship between two or more things.

The student knows, explains, and uses mathematical models such as:

graphs and tables using real objects, representational objects or abstract representations to display data.
place value models such as place value mats, hundreds charts, and base ten blocks.
process models for whole number operations such as pictures or objects representing addition and subtraction, the number line, or the hundreds chart.
Venn Diagrams to sort data using two attributes.
diagrams and pictures to model situations.

Application

The student:

1. recognizes the same situation can be represented in more than one way.

Special Note: The mathematical modeling process involves:

a) selecting key features and relationships within the real world situation and representing these concepts in mathematical terms through some sort of mathematical model;
b) performing manipulations and mathematical procedures within the mathematical model;
c) interpreting the results of the manipulations within the mathematical model and using these results to make inferences about the original real-world situation.

Possible Kindergarten Indicators

Knowledge Base

The student:

1. uses mathematical models to represent and explain mathematical concepts and procedures.
2. uses concrete objects, diagrams, pictures and dramatizations to show the relationship between two or more things.

The student knows, explains, and uses mathematical models such as:

graphs and tables using real objects or organize and display data.
concrete objects and pictures.

Application

The student:

1. recognizes the same situation can be represented in more than one way.

Special Note: The mathematical modeling process involves:

a) selecting key features and relationships within the real world situation and representing these concepts in mathematical terms through some sort of mathematical model;
b) performing manipulations and mathematical procedures within the mathematical model;
c) interpreting the results of the manipulations within the mathematical model and using these results to make inferences about the original real-world situation.

Δ This indicator will be assessed at the state level.
N The use of calculators, abacuses or computers will not be allowed during the assessment of this indicator at the state level.
Indicators are not listed in priority order, nor are they considered as all inclusive.

Standard: The student uses geometric concepts and procedures in a variety of situations.

Tenth Grade Benchmark: *The student recognizes geometric figures, and applies, compares, and justifies the properties of geometric figures in a variety of situations.*

Tenth Grade Indicators

Knowledge Base

The student:

1. uses appropriate technology, manipulatives, constructions or drawings to recognize, compare and explain properties of geometric figures.
2. recognizes, classifies and discusses properties of all geometric figures listed in previous grade level indicators plus the following figures: any two-dimensional figure including parabolas and sectors of circles.
3. recognizes, classifies and discusses properties of ellipses, hyperbolas, secant lines, and tangent lines, and intersections of two-dimensional figures and three-dimensional figures with each other.
4. recognizes, explains and compares parallel line properties including angle relationships created by a transversal.
5. recognizes, explains and compares the following properties: congruence properties of triangles such as SSS, ASA, SAS, AAS, and HL; angle relationships of triangles, ratios in special right triangles such as 30-60-90 and 45-45-90; and central and inscribed angles.
6. applies the Pythagorean theorem to determine if a triangle is a right triangle or to find a missing side of a right triangle.
7. recognizes and applies properties of corresponding parts of congruent and similar figures to find missing sides.
8. explains or uses symbols for congruence, similarity, arc, and circle.

Application

The student:

1. uses definitions, axioms, theorems and deductive reasoning to justify the following:
   a) parallel line properties including angle relationships created by a transversal.
   b) angle relationships in triangles such as the base angles of an isosceles triangle are equal or the sum of the angles in a triangle equals 180 degrees.

Δ 2. formulates and solves real-world problems by applying properties of geometric figures.
For the purpose of assessing this indicator on the Kansas Assessment the student is expected to be able to:
a) recognize, explain and compare parallel line properties including angle relationships created by a transversal.
b) apply the Pythagorean theorem to determine if a triangle is a right triangle or to find a missing side of a right triangle.
c) recognize and apply properties of corresponding parts of congruent and similar figures to find missing sides.
d) apply angle and side properties of squares, rectangles, triangles, trapezoids, and parallelograms such as: the opposite sides of a parallelogram are equal and parallel; a right triangle has one angle which is 90°; or the sum of the angles of a triangle equals 180°.
e) use symbols and definitions for perpendicular, parallel, triangle, and right angle.
f) determine the radius or diameter of a circle.

3. uses definitions, axioms, theorems and deductive reasoning to justify the following properties of geometric figures:
   a) congruence properties of triangles (SSS, ASA, AAS, and HL)
   b) ratios in special right triangles.
   c) central and inscribed angles.

(continued on next page)

Δ This indicator will be assessed at the state level.
N The use of calculators, abacuses or computers will not be allowed during the assessment of this indicator at the state level.
Indicators are not listed in priority order, nor are they considered as all inclusive.

Standard: The student uses geometric concepts and procedures in a variety of situations.

Tenth Grade Benchmark: The student recognizes geometric figures, and applies, compares, and justifies the properties of geometric figures in a variety of situations.

Tenth Grade Indicators (continued)

4. understands the concepts of and develops both formal and informal proof through understanding of the difference between a statement verified by mathematical proof (i.e. theorem) and a statement verified by using examples.

Possible Eighth Grade Indicators

Knowledge Base

The student:

1. recognizes, classifies and discusses properties of all geometric figures listed in previous grade level indicators plus the following figures: point, line, plane.
2. knows angle relationships formed by parallel lines cut by a transversal using appropriate technology (alternate interior, alternate exterior, supplementary, vertical angles, corresponding angles, complementary, consecutive interior).
3. recognizes and discusses the symmetry that exists in three-dimensional figures.
4. recognizes the following figures and explains their attributes: arc, chord, and semicircle.
5. knows and explains how to use appropriate technology, manipulatives, constructions, or drawings to recognize, classify and compare geometric figures.
6. recognizes or applies properties of corresponding parts of similar and congruent triangles and quadrilaterals.

Application

The student:

1. formulates and solves real-world problems by applying properties of geometric figures.
2. knows, explains, and uses triangle inequality properties to determine if a triangle exists.

Δ This indicator will be assessed at the state level.
N The use of calculators, abacuses or computers will not be allowed during the assessment of this indicator at the state level.
Indicators are not listed in priority order, nor are they considered as all inclusive.

Standard: The student uses geometric concepts and procedures in a variety of situations.

Seventh Grade Benchmark: The student recognizes, applies, and compares properties of geometric figures in a variety of situations.

Seventh Grade Indicators

Knowledge Base

The student:

1. recognizes and uses properties of all geometric figures listed previously, plus the following figures: trapezoid and parallelogram.
2. classifies triangles as scalene, isosceles, equilateral, acute, right, obtuse, and equiangular, and polygons as regular, irregular, and/or by the number of sides.
3. recognizes or applies properties of corresponding parts of similar and congruent triangles and quadrilaterals.
4. uses symbols for perpendicular, parallel, triangle, and right angle.
5. uses appropriate technology, manipulatives, constructions or drawings to recognize or compare geometric figures.
6. determines if a triangle can be constructed from three different lengths.

Application

The student:

Δ 1. formulates and solves real-world problems by applying properties of geometric figures.
For the purpose of assessing this indicator on the Kansas Assessment the student is able to:
a) apply angle and side properties of squares, rectangles, triangles, trapezoids, and parallelograms such as the opposite sides of a parallelogram are equal and parallel or a right triangle has one angle which is 90° or the sum of the angles of a triangle equals 180°. Students do NOT need to be able to use the Pythagorean theorem.
b) classify triangles as scalene, isosceles, equilateral, acute, right, obtuse, and equiangular, and polygons as regular, irregular, and/or by the number of sides.
c) use symbols for perpendicular, parallel, triangle, and right angle.
d) use drawings to recognize or compare geometric figures.
e) determine the radius or diameter of a circle.

Possible Sixth Grade Indicators

Knowledge Base

The student:

1. recognizes all geometric figures listed in previous benchmarks and indicators plus the following figures, rays and angles as right, acute, obtuse, and straight.
2. recognizes triangles as scalene, isosceles, and equilateral.
3. recognizes regular and irregular polygons.
4. recognizes similar and congruent triangles and quadrilaterals.
5. uses symbols for angle, line, line segment, and ray.
6. uses appropriate technology, manipulatives, constructions or drawings to recognize, apply or compare geometric figures.
7. recognizes parallel lines.

Application

The student:

1. formulates and solves real-world problems by applying properties of geometric figures.

Δ This indicator will be assessed at the state level.
N The use of calculators, abacuses or computers will not be allowed during the assessment of this indicator at the state level.
Indicators are not listed in priority order, nor are they considered as all inclusive.

Standard: The student uses geometric concepts and procedures in a variety of situations.

Seventh Grade Benchmark: The student recognizes, applies, and compares properties of geometric figures in a variety of situations.

Possible Fifth Grade Indicators

Knowledge Base

The student:

1. uses appropriate technology, manipulatives, or drawings to recognize and investigate properties of simple geometric figures.
2. recognizes and describes regular polygons having up to ten sides.
3. recognizes an ellipse.
4. recognizes, draws or describes points, lines, line segments, rays, and angles as right, obtuse or acute.
5. identifies and explains circumference, radius, and diameter.
6. identifies faces, edges, and bases on three dimensional objects.
7. recognizes perpendicular lines.

Application

The student:

1. formulates and solves real-world problems by applying properties of geometric figures.

Fourth Grade Benchmark: The student recognizes or investigates properties of simple geometric figures in a variety of situations.

Fourth Grade Indicators

Knowledge Base

The student:

1. uses appropriate technology, manipulatives, and drawings to recognize and investigate properties of simple geometric figures.
2. recognizes and describes the following geometric figures and their basic properties: rhombus, octagon, pentagon, circle, square, rectangle, triangle, and ellipse (oval).
3. recognizes and describes the following geometric solids: pyramid, triangular prism, rectangular prism, cylinder, cone, sphere and cube.
4. identifies faces, edges, vertices (corners) and bases on three-dimensional objects.
5. recognizes and describes similar and congruent figures.
6. identifies the radius and diameter of a circle.

Application

The student:

1. formulates and solves real-world problems by applying basic properties of simple geometric figures.

NΔ 2. categorizes a composite figure into the shapes used to form it. *For the purpose of assessing this indicator on the Kansas Assessment the student should be able to recognize the following figures which were used to form a composite shape: square, rhombus, octagon, pentagon, circle, square, rectangle, triangle, and ellipse (oval).*

Δ This indicator will be assessed at the state level.
N The use of calculators, abacuses or computers will not be allowed during the assessment of this indicator at the state level.
Indicators are not listed in priority order, nor are they considered as all inclusive.

Standard: The student uses geometric concepts and procedures in a variety of situations.

Fourth Grade Benchmark: The student recognizes or investigates properties of simple geometric figures in a variety of situations.

Possible Third Grade Indicators

Knowledge Base

The student:

1. uses appropriate technology, manipulatives or drawings to recognize and investigate properties of simple geometric figures.
2. recognizes and describes rhombus, octagon, pentagon.
3. recognizes and describes the following geometric figures: cylinder, cone, sphere and cube.
4. determines if a figure contains any lines of symmetry and draws them if they exist.
5. recognizes similar and congruent figures.

Application

The student:

1. formulates and solves real-world problems by applying basic properties of geometric figures.
2. combines several geometric shapes to make a larger shape.

Second Grade Benchmark: The student recognizes and describes properties of simple geometric shapes.

Second Grade Indicators

Knowledge Base

The student:

1. uses appropriate technology, manipulatives and drawings to recognize or investigate properties of geometric figures.
2. compares the following geometric figures: circle, square, rectangle, triangle, and ellipse (oval).
3. recognizes, draws, and describes the following geometric figures: circle, square, rectangle, triangle, and ellipse (oval).
4. recognizes the following figures from a basic pattern block set: square, triangle, rhombus, hexagon, parallelogram and trapezoid.
5. recognizes the following geometric solids: cubes, cylinders, cones, and spheres.

Application

The student:

1. formulates and solves real-world problems by applying properties of geometric figures.
2. categorizes a composite figure into the shapes used to form it.
3. combines several geometric shapes to make a larger shape.

Δ This indicator will be assessed at the state level.
N The use of calculators, abacuses or computers will not be allowed during the assessment of this indicator at the state level.
Indicators are not listed in priority order, nor are they considered as all inclusive.

Standard: The student uses geometric concepts and procedures in a variety of situations.

Second Grade Benchmark: The student recognizes and describes properties of simple geometric shapes.

Possible First Grade Indicators

Knowledge Base

The student:
1. uses appropriate technology, manipulatives and drawings to recognize and investigate properties of geometric figures.
2. recognizes and draws circle, square, rectangle, triangle and ellipse (oval).

Application

The student:
1. categorizes a composite figure into the shapes used to form it.
2. combines several geometric shapes to make a larger shape.
3. recognizes shapes within a picture.
4. recognizes shapes that have symmetry.
5. sorts shapes by specific attributes

Possible Kindergarten Indicators

Knowledge Base

The student:
1. recognizes a circle, square, triangle, ellipse (oval), and rectangle.
2. uses appropriate technology, manipulatives and drawings to recognize or investigate properties of geometric figures.

Application

The student:
1. recognizes and names shapes within their environment.
2. sorts concrete objects by specific attributes

Δ This indicator will be assessed at the state level
N The use of calculators, abacuses or computers will not be allowed during the assessment of this indicator at the state level.
Indicators are not listed in priority order, nor are they considered as all inclusive.

Standard: The student uses geometric concepts and procedures in a variety of situations.

Tenth Grade Benchmark: The student estimates, measures and uses geometric formulas in a variety of situations.

Tenth Grade Indicators

Knowledge Base

The student:

1. uses various estimation techniques to determine real number approximations of length, volume, surface area, area, perimeter, weight, capacity, temperature, distance, time and angle measurement.
2. states, recognizes or applies formulas for area and perimeter for triangles, rectangles, and squares, the circumference and area of circles, volume of rectangular solids, and distance on a number line.
3. applies various measurement formulas to two- and three-dimensional figures (regular and irregular) including volume, surface area, area, perimeter, and distance when given the formula.
4. applies various measurement techniques to find accurate real number representations for length, volume, capacity, surface area, area, distance, weight, mass, temperature, distance, midpoint, time, and angle measurements with the appropriate formula provided.
5. explains how simple measurement formulas involving circles, parallelograms, trapezoids, cubes, and cylinders are derived.
6. selects, explains the selection and uses measurement tools, units of measure, and degrees of accuracy appropriate to the given situation.
7. knows, explains, and uses quotients of two different measures to describe rates of change.
8. approximates conversions between the standard and metric measurement systems given the conversion units or formulas.
9. recognizes and applies properties of corresponding parts of congruent and similar figures to find measurements of missing sides.

Application

The student:

Δ 1. formulates and solves real-world problems by applying measurements and measurement formulas.
For the purpose of assessing this indicator on the Kansas Assessment the student is expected to be able to:
a) state, recognize or apply formulas for areas and perimeters of triangles, rectangles, and squares, the circumference and areas of circles, volume of rectangular solids, and distance on the number line.
b) apply various measurement formulas to two- and three-dimensional figures (regular and irregular) including volume, surface area, area, and distance when given the formula.
c) apply the Pythagorean theorem to determine if a triangle is a right triangle or to find a missing side of a right triangle.
d) perform conversions within the standard or metric measurement system.

2. uses estimation to check reasonableness of measurements and calculations and/or adjusts original measurements based on additional information (estimation from a frame of reference).
3. uses indirect measurements to measure inaccessible objects.

Δ This indicator will be assessed at the state level.
N The use of calculators, abacuses or computers will not be allowed during the assessment of this indicator at the state level.
Indicators are not listed in priority order, nor are they considered as all inclusive.

Standard: The student uses geometric concepts and procedures in a variety of situations.

Tenth Grade Benchmark: *The student estimates, measures and uses geometric formulas in a variety of situations.*

Possible Eighth Grade Indicators

Knowledge Base

The student:

1. uses various estimation techniques to determine rational number approximations of surface area, weight, and capacity.
2. uses given measurement formulas for two- and three-dimensional figures including area of a trapezoid, volume of a cylinder and triangular prism, and surface area of a cylinder and triangular prism.
3. applies various measurement techniques, uses appropriate tools; units of measure and degree of accuracy to find accurate real number representations for length, volume, surface area, area, perimeter, weight, capacity, temperature, time and angle measurements.
4. explains how simple measurement formulas involving squares, rectangles, and triangles work.
5. uses ratios and proportions to measure inaccessible objects.
6. performs conversions within each system of measurement.

Application

The students:

1. formulates and solves real-world problems by applying measurements and measurement formulas.
2. uses estimation to check reasonableness of measurements and calculations and/or adjusts original measurements based on additional information (estimation from a frame of reference).

Δ This indicator will be assessed at the state level.
N The use of calculators, abacuses or computers will not be allowed during the assessment of this indicator at the state level.
Indicators are not listed in priority order, nor are they considered as all inclusive.

Standard: The student uses geometric concepts and procedures in a variety of situations.

Seventh Grade Benchmark: The student estimates, measures, and uses measurement formulas in a variety of situations.

Seventh Grade Indicators

Knowledge Base

The student:

1. uses various estimation techniques to determine rational number approximations of length, volume, surface area, area, perimeter, weight, capacity, temperature or time.
2. recognizes, states and uses measurement formulas for perimeter and area of parallelograms, triangles, squares, rectangles, and circles plus the volume of a cube.

NΔ 3. applies measurement formulas which are given to three-dimensional figures including surface area of cubes and volume and surface area of rectangular prisms.

4. finds area and perimeter of two-dimensional figures composed of squares, rectangles, triangles, and circles.
5. applies various measurement techniques and uses appropriate tools, units of measure and degree of accuracy to find accurate rational number representations for length, volume, surface area, area, perimeter, weight, temperature and time.
6. uses appropriate units to describe rate as a unit of measure such as miles per hour.
7. finds missing angle measurements in triangles and quadrilaterals.
8. performs conversions within the standard measurement system.
9. performs conversions within the metric measurement system.

Application

The student:

Δ 1. formulates and solves real-world problems by applying measurements and measurement formulas.
For the purpose of assessing this indicator on the Kansas Assessment the student should be able to:
a) recognize, state, and use measurement formulas for perimeter and area of parallelograms, triangles, squares, rectangles, and circles plus the volume of a cube.
b) apply measurement formulas which are given to three-dimensional figures including surface area of cubes and volume and surface area of rectangular prisms.
c) find area and perimeter of two-dimensional figures composed of squares, rectangles, triangles, and circles.
d) apply various measurement techniques and uses appropriate tools, units of measure and degree of accuracy to find accurate rational number representations for length, volume, surface area, area, perimeter, weight, temperature and time.
e) use appropriate units to describe rate as a unit of measure. example: miles per hour
f) find missing angle measurements in triangles and quadrilaterals.
g) perform conversions within the standard or metric measurement system.

2. uses estimation to check reasonableness of measurements and calculations and/or adjusts original measurements based on additional information (estimation from a frame of reference).

Δ This indicator will be assessed at the state level.
N The use of calculators, abacuses or computers will not be allowed during the assessment of this indicator at the state level.
Indicators are not listed in priority order, nor are they considered as all inclusive.

Standard: The student uses geometric concepts and procedures in a variety of situations.

Seventh Grade Benchmark: The student estimates, measures, and uses measurement formulas in a variety of situations.

Possible Sixth Grade Indicators

Knowledge Base

The student:

1. uses various estimation techniques to determine whole number approximations of length, volume, area, perimeter, weight, capacity, temperature and time.
2. recognizes and states measurement formulas for areas and perimeters of squares and rectangles.
3. applies given measurement formulas including area and perimeter to two-dimensional figures.
4. applies various measurement techniques and uses appropriate tools, units of measure, and degrees of accuracy to find accurate rational number representations for length, area, perimeter, temperature and time.
5. performs conversions within standard measurement systems.
6. performs conversions within the metric measurement system such as millimeters to meters.
7. uses standard units of measurement up to the nearest sixteenth of an inch, metric measurements up to the nearest millimeter.
8. selects, explains the selection, or uses measurement tools, units of measure, and degrees of accuracy appropriate to the given situation.

Application

The student:

1. formulates and solves real-world problems by applying measurements and measurement formulas.
2. uses estimation to check reasonableness of measurements and calculations and/or adjusts original measurements based on additional information (estimation from a frame of reference).

Δ This indicator will be assessed at the state level.
N The use of calculators, abacuses or computers will not be allowed during the assessment of this indicator at the state level.
Indicators are not listed in priority order, nor are they considered as all inclusive.

Standard: The student uses geometric concepts and procedures in a variety of situations.

Seventh Grade Benchmark: The student estimates, measures, and uses measurement formulas in a variety of situations.

Possible Fifth Grade Indicators

Knowledge Base

The student:

1. knows and uses area and perimeter formulas for rectangles and squares.
2. uses standard units of measurement to the nearest eighth and fourth inch, metric measurement to the nearest whole centimeter, meter, and kilometer, or nonstandard unit of measure to the nearest whole unit.
3. selects, explains the selection of, or uses measurement tools, units of measure and degrees of accuracy appropriate to the given situation.
4. performs conversions within the standard and metric measurement systems such as millimeters to centimeters.

Application

The student:

1. formulates and solves real-world problems by applying measurements and measurement formulas.
2. uses estimation to check reasonableness of measurements and calculations.
3. adjusts original measurements based on additional information (estimation from a frame of reference).
4. uses map scales to measure distance between locations and makes simple scale drawings using grid paper.

Δ This indicator will be assessed at the state level.
N The use of calculators, abacuses or computers will not be allowed during the assessment of this indicator at the state level.
Indicators are not listed in priority order, nor are they considered as all inclusive.

Standard: The student uses geometric concepts and procedures in a variety of situations.

Fourth Grade Benchmark: The student estimates and measures using standard and nonstandard units in a variety of situations.

Fourth Grade Indicators

Knowledge Base

The student:

1. uses appropriate estimation techniques to find whole number approximations of area, perimeter, length, width, distance, weight, temperature, capacity, or time.
2. finds the perimeter of two-dimensional figures given the measure of all the sides.
3. applies appropriate measurement techniques to find accurate representations for area, perimeter, length, width, distance, weight, volume, temperature and time.

NΔ 4. selects, explains the selection of, and uses measurement tools, units of measure, and degrees of accuracy appropriate to the given situation to measure length to the nearest fourth of an inch, nearest centimeter; volume to the nearest pint, cup, quart, gallon or liter and nonstandard units of measure to the nearest whole unit; weight to the nearest pound or ounce and nonstandard units of measure to the nearest whole unit; and temperature to the nearest degree; and units of time.

5. performs conversions within the same measurement system such as inches to feet, feet to yards, inches to yards, quarts to gallons, pints to quarts, cups to pints, pounds to ounces, or centimeters to meters.

Application

The student:

NΔ 1. formulates and solves real-world problems by applying measurements and measurement formulas.
For the purpose of assessing this indicator on the Kansas Assessment the student should be able to work with the following measurements and conversions:
a) area of rectangles and squares
b) perimeter
c) length to the nearest fourth of an inch, nearest centimeter and nonstandard units of measure to the nearest whole unit; volume to the nearest pint, cup, quart, gallon or liter; temperature to the nearest degree; and weight to the nearest pound or ounce.
d) conversions within the same measurement system such as going back and forth between inches and feet, feet and yards, inches and yards, quarts and gallons, pints and quarts, cups and pints, pounds and ounces, or centimeters and meters.
e) units of time

2. uses estimation to check reasonableness of measurements and calculations.
3. adjusts original measurements based on additional information (estimation from a frame of reference).
4. uses map scales to measure distance between locations.

Δ This indicator will be assessed at the state level.
N The use of calculators, abacuses or computers will not be allowed during the assessment of this indicator at the state level.
Indicators are not listed in priority order, nor are they considered as all inclusive.

Standard: The student uses geometric concepts and procedures in a variety of situations.

Fourth Grade Benchmark: The student estimates and measures using standard and nonstandard units in a variety of situations.

Possible Third Grade Indicators

Knowledge Base

The student:

1. finds the perimeter of squares, rectangles, and triangles given the measure of all the sides.
2. selects, uses, or explains measurement tools and units of measure appropriate for the situation.
3. states the number of hours in a day and days in a year.
4. understands appropriate uses of length, width, height, and temperature.
5. measures length to the nearest half inch, to the nearest centimeter or nonstandard units of measure to nearest whole unit; volume to the nearest pint, cup, quart, gallon or liter; temperature to the nearest degree.
6. selects, explains the selection of, or uses measurement tools, units of measure, and degrees of accuracy appropriate to a given situation.
7. reads and tells time to the minute on analog and digital clocks.

Application

The student:

1. formulates and solves real-world problems by applying measurements and measurement formulas.
2. uses estimation to check reasonableness of measurements and calculations.
3. adjusts original measurements based on additional information (estimation from a frame of reference).
4. uses map scales to measure distance between locations.

A This indicator will be assessed at the state level.
N The use of calculators, abacuses or computers will not be allowed during the assessment of this indicator at the state level.
Indicators are not listed in priority order, nor are they considered as all inclusive.

Standard: The student uses geometric concepts and procedures in a variety of situations.

Second Grade Benchmark: *The student estimates and measures using standard and nonstandard units in a variety of situations with an emphasis on the use of concrete materials.*

Second Grade Indicators

Knowledge Base

The student:

1. measures length to the nearest inch, to the nearest centimeter, and nonstandard units of length to the nearest whole unit; volume to the nearest pint, cup, quart, gallon or liter; temperature to the nearest degree.
2. selects or uses measurement tools for length, volume, temperature, and weight, and units of measure appropriate for the given situation.
3. states the number of minutes in an hour.
4. reads and tells time to the nearest quarter-hour using analog and digital clocks.

Application

The student:

1. formulates and solves real-world problems by applying measurements and measurement formulas.
2. uses estimation to check reasonableness of measurements and calculations.
3. adjusts original measurements based on additional information (estimation from a frame of reference).
4. uses a balance to compare the weights of more than two objects.

Possible First Grade Indicators

Knowledge Base

The student:

1. measures using nonstandard units to the nearest whole unit for length and weight.
2. selects appropriate measuring tools for length, volume, temperature, and weight for a given situation.
3. states number of days in a week and months in a year.
4. uses appropriate vocabulary to compare measurement: taller, shorter (height), hotter, colder (temperature), shorter, longer (length), heavier, lighter (weight).
5. reads and tells time at the half-hour using analog and digital clocks.

Application

The student:

1. orders objects by size.
2. locates and names objects which are about the same size as a given object.
3. uses a balance to compare the weights of two objects.

Possible Kindergarten Indicators

Knowledge Base

The student:

1. uses appropriate vocabulary to compare two measurements: taller, shorter (height), hotter, colder (temperature), shorter, longer (length).
2. reads and tells time at the hour using analog and digital clocks.

Application

The student:

1. compares and orders objects by size.
2. locates and names objects which are about the same size as a given object.

Δ This indicator will be assessed at the state level.
N The use of calculators, abacuses or computers will not be allowed during the assessment of this indicator at the state level.
Indicators are not listed in priority order, nor are they considered as all inclusive.

Standard: The student uses geometric concepts and procedures in a variety of situations.

Tenth Grade Benchmark: The student recognizes and applies transformation of two- and three-dimensional figures in a variety situations.

Tenth Grade Indicators

Knowledge Base

The student:

1. recognizes and describes single and multiple transformations [(rotation in ninety degree intervals, reflection, translation, shrink or magnify (dilate)] to two- and three-dimensional figures.
2. explains and performs single and multiple transformations [rotation, reflection, translation, shrink or magnify (dilate)] on two- and three-dimensional figures.
3. recognizes and describes the three-dimensional figure created by rotating a two-dimensional shape around a fixed line.
4. determines the actual dimensions/measurements or shape of a three-dimensional model from a two-dimensional drawing.
5. creates a two-dimensional scale drawing of a three-dimensional shape.

Application

The student:

1. uses a variety of scales to view and analyze two- and three-dimensional figures.
2. uses visualization and spatial reasoning to represent, formulate and solve real-world problems.
3. represents geometric transformations using sketches, coordinate systems, vectors, or matrices.

Δ 4. analyzes the impact of transformations on area and perimeter of triangles and circles and on volume of cylinders and rectangular prisms.
For the purpose of assessing this indicator on the Kansas Assessment the student should be able to recognize and describe simple and multiple transformations (rotations in ninety degree intervals, reflection, translation shrink or magnify [dilate]) to two- and three-dimensional figures.

5. analyzes the impact of transformations on geometric figures within the coordinate plane.
6. describes and draws three-dimensional shapes as they would appear after undergoing two specified transformations without actually performing the transformations with concrete objects.

Δ This indicator will be assessed at the state level.
N The use of calculators, abacuses or computers will not be allowed during the assessment of this indicator at the state level.
Indicators are not listed in priority order, nor are they considered as all inclusive.

Standard: The student uses geometric concepts and procedures in a variety of situations.

Tenth Grade Benchmark: The student recognizes and applies transformation of two- and three-dimensional figures in a variety situations.

Possible Eighth Grade Indicators

Knowledge Base

The student:

1. recognizes, explains, and performs single and multiple transformations [rotation, reflection, translation, shrink or magnify (dilate)] to two-dimensional figures.
2. performs reflections of two-dimensional figures in the coordinate plane, over the x- and y-axis.
3. creates a scale drawing of a two-dimensional shape.
4. draws three-dimensional shapes as they would appear from a variety of visual perspectives (top, bottom, side, and corner).
5. creates a two-dimensional drawing of a three-dimensional shape.

Application

The student:

1. explains the impact of transformations on the volume of a cube and area of a parallelogram.
2. uses transformations to examine symmetrical properties of geometric figures.
3. discusses and discerns relationships among combinations of reflections, translations and rotations.
4. describes and draws two-dimensional shapes as they would appear after undergoing two specified transformations and three-dimensional shapes as they would appear after undergoing one specified transformation without actually performing the transformation(s) with concrete objects.

Seventh Grade Benchmark: The student recognizes and performs transformations of two-dimensional figures in a variety situations.

Seventh Grade Indicators

Knowledge Base

The student:

Δ 1. recognizes, describes, and performs single and multiple transformations [rotation, reflection, translation, shrink or magnify (dilate)] on two-dimensional figures.
2. creates a tessellation.
Δ 3. recognizes and draws three-dimensional shapes as they would appear from a variety of visual perspectives (top, bottom, side, and corners).

Application

The student:

Δ 1. uses a scale drawing to determine the actual dimensions/measurements of the figure represented in the drawing.
2. explains the impact of transformation on area and perimeter of squares and rectangles.
3. uses transformations to examine symmetrical and congruence properties of geometric figures.

Δ This indicator will be assessed at the state level.
N The use of calculators, abacuses or computers will not be allowed during the assessment of this indicator at the state level.
Indicators are not listed in priority order, nor are they considered as all inclusive.

Standard: The student uses geometric concepts and procedures in a variety of situations.

Seventh Grade Benchmark: The student recognizes and performs transformations of two-dimensional figures in a variety situations.

Possible Sixth Grade Indicators

Knowledge Base

The student:

1. recognizes, explains and performs up to two transformations on two-dimensional figures.
2. recognizes a tessellation.
3. recognizes or draws three-dimensional shapes as they would appear from a variety of visual perspectives (top, bottom, side).

Application

The student:

1. describes and draws two dimensional shapes as they would appear after undergoing two specified transformations without actually performing the transformations with concrete objects.

Possible Fifth Grade Indicators

Knowledge Base

The student:

1. recognizes, explains and performs up to two transformations on two-dimensional figures.
2. recognizes how pyramids, triangular prisms, rectangular prisms, cylinders, cones, and spheres would appear from a variety of visual perspectives (top, bottom, side, and corners).

Application

The student:

1. describes and draws two-dimensional shapes as they would appear after undergoing two specified transformations without actually performing the transformations with concrete objects.

Fourth Grade Benchmark: The student recognizes up to two transformations of basic geometric figures in a variety situations.

Fourth Grade Indicators

Knowledge Base

The student:

NΔ 1. recognizes and performs up to two transformations (rotation/turn, reflection/flip, translation/slide) on simple two-dimensional shapes and uses cardinal or positional directions to describe translations such as move the triangle three units to the right and two units up.

Application

The student:

1. describes or draws two-dimensional shapes as they would appear after undergoing a specified transformation without actually performing the transformation with concrete objects.
2. discusses what properties of basic shapes stay the same and what changes when a transformation is performed.
3. recognizes how pyramids, triangular prisms, and rectangular prisms would appear from a variety of visual perspectives (top, bottom, side, and corners).
4. gives or uses directions to move from one location to the another on a map or grid.

Δ This indicator will be assessed at the state level.
N The use of calculators, abacuses or computers will not be allowed during the assessment of this indicator at the state level.
Indicators are not listed in priority order, nor are they considered as all inclusive.

Standard: The student uses geometric concepts and procedures in a variety of situations.

Fourth Grade Benchmark: *The student recognizes up to two transformations of basic geometric figures in a variety situations.*

Possible Third Grade Indicators

Knowledge Base

The student:

1. recognizes or performs one transformation (rotation/turn, reflection/flip, and translation/slide) on basic two-dimensional shapes.
2. knows and uses cardinal directions (north, south, east, west, northeast, southwest, etc.)

Application

The student:

1. describes or draws basic two-dimensional shapes as they would appear after undergoing a specified transformation without actually performing the transformation with concrete objects.
2. recognizes and explains real-life situations where transformations take place.
3. gives or uses directions to move from one location to another on a map.

Δ This indicator will be assessed at the state level.
N The use of calculators, abacuses or computers will not be allowed during the assessment of this indicator at the state level.
Indicators are not listed in priority order, nor are they considered as all inclusive.

Standard: The student uses geometric concepts and procedures in a variety of situations.

Second Grade Benchmark: The student recognizes and describes a single geometric transformation of simple shapes or objects in a variety of situations.

Second Grade Indicators

Knowledge Base

The student:

1. recognizes when a simple shape has undergone one transformation (rotation/turn, reflection/flip, and translation/slide).
2. recognizes two- or three-dimensional objects as they would appear from near or far.

Application

The student:

1. shows two simple shapes are congruent by physically fitting one shape on top of the other.
2. gives or follows directions to move objects from one location to another.

Possible First Grade Indicators

Knowledge Base

The student:

1. uses common spatial sense language such as behind, above, below, under, beside and in front of to describe the relationship between two objects.
2. knows that changing an object's position or orientation does not change its shape.

Application

The student:

1. shows two simple shapes are congruent by physically fitting one shape on top of the other.
2. gives or follows directions to move objects from one location to another.

Possible Kindergarten Indicators

Knowledge Base

The student:

1. identifies two like shapes from a set of four.
2. uses common spatial sense language such as above and below.

Application

The student:

1. shows two shapes are congruent by physically fitting one shape on top of the other.
2. gives or follows directions to move objects from one location to another.

A This indicator will be assessed at the state level.
N The use of calculators, abacuses or computers will not be allowed during the assessment of this indicator at the state level.
Indicators are not listed in priority order, nor are they considered as all inclusive.

Standard: The student uses geometric concepts and procedures in a variety of situations.

Tenth Grade Benchmark: The student uses an algebraic perspective to analyze the geometry of two- and three-dimensions in a variety of situations.

Tenth Grade Indicators

Knowledge Base

The student:

1. uses a variety of methods including mental mathematics, paper and pencil, concrete materials, and graphing utilities and other technological tools to recognize and examine the geometry of two- and three-dimensional figures.
2. determines if a given point lies on the graph of a given line or parabola without graphing, and justifies his/her answer.

Δ 3. calculates the slope of a line from a list of ordered pairs on the line and explains how the graph of the line is related to its slope.

Δ 4. finds or explains the relationship between the slopes of perpendicular and parallel lines.

5. uses the distance formula, slopes, and/or the Pythagorean theorem to find the missing side of any right triangle or to determine if a triangle is a right triangle when the triangle is presented on the coordinate plane.

NΔ 6. recognizes an equation of a line in any form and transforms the equation into slope-intercept form in order to identify characteristics such as slope and the y-intercept and uses this form to graph the line.

7. recognizes an equation of a parabola in any form and identifies characteristics of the parabola such as the vertex, the maximum or minimum value, the line of symmetry, and the direction of the concavity, and sketches a graph of the parabola.
8. explains the relationship between the solution(s) to systems of equations and/or inequalities in two unknowns and their graphs (linear programming).
9. solves problems involving rate as a measure of change such as velocity or acceleration.

Application

The student:

1. analyzes how changes in constants and/or coefficients within the equation of a line or parabola changes the appearance of the graph of the equation.
2. translates between the algebraic representation of a problem and the geometric representation of a problem.
3. represents, formulates and solves distance and geometry problems using the language and symbols of algebra and the coordinate plane.
4. recognizes and explains the affects of scale changes on the appearance of the graph of an equation or inequality involving a line or parabola.

Δ This indicator will be assessed at the state level.
N The use of calculators, abacuses or computers will not be allowed during the assessment of this indicator at the state level.
Indicators are not listed in priority order, nor are they considered as all inclusive.

Standard: The student uses geometric concepts and procedures in a variety of situations.

Tenth Grade Benchmark: The student uses an algebraic perspective to analyze the geometry of two- and three-dimensions in a variety of situations.

Possible Eighth Grade Indicators

Knowledge Base

The student:

1. uses a variety of methods including mental mathematics, paper and pencil, concrete materials, graphing utilities and other technological tools to analyze two-dimensional geometry on the coordinate plane.
2. creates a T-table from a linear equation and plots ordered pairs.
3. lists five coordinate pairs on the graph of a line and states the pattern that exists.
4. determines the length of a side of a figure drawn on a coordinate plane with vertices having the same x-coordinates or y-coordinates.
5. recognizes that ordered pairs that lie on the graph of an equation are solutions to that equation.
6. recognizes that points that do not lie on the graph of an equation are not solutions to that equation.

Application

The student:

1. represents, formulates and solves distance and geometry problems using the language and symbols of algebra and the coordinate plane.

A This indicator will be assessed at the state level.
N The use of calculators, abacuses or computers will not be allowed during the assessment of this indicator at the state level.
Indicators are not listed in priority order, nor are they considered as all inclusive.

Standard: The student uses geometric concepts and procedures in a variety of situations.

Seventh Grade Benchmark: The student will analyze two-dimensional geometry using a coordinate system in a variety of situations.

Seventh Grade Indicators

Knowledge Base

The student:

1. uses a variety of methods including mental mathematics, paper and pencil, concrete materials, graphing utilities and other technological tools to analyze two-dimensional geometry on the coordinate system.

NΔ 2. uses the coordinate plane to:
   a) identify in which quadrant or on which axis a point lies when given the coordinates of the point.
   b) graph or identify points on the coordinate plane in all four quadrants.
   c) determine if a given point is on the line given the graph of the line.
   d) list up to five coordinate pairs on the graph of a line and then state the pattern that exists.

3. finds the distance between the points on a number line by computing the absolute value of their difference.

Application

The student:

1. represents, formulates and solves distance problems using a number line.
2. represents, formulates and solves area and perimeter problems involving squares, rectangles, and triangles on the coordinate plane.
3. represents, formulates and solves real world geometry problems by using algebraic notation, equations, or inequalities.

Possible Sixth Grade Indicators

Knowledge Base

The student:

1. graphs or identifies points on the coordinate plane in the first quadrant.
2. uses T-tables.
3. recognizes and plots ordered pairs on the coordinate plane.
4. explains relationships among mixed numbers and decimals as they appear on a number line.

Application

The student:

1. represents, formulates and solves distance problems by using a number line.
2. represents, formulates and solves area and perimeter problems on the coordinate plane.

Δ This indicator will be assessed at the state level.
N The use of calculators, abacuses or computers will not be allowed during the assessment of this indicator at the state level.
Indicators are not listed in priority order, nor are they considered as all inclusive.

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Standard: The student uses geometric concepts and procedures in a variety of situations.

Seventh Grade Benchmark: The student will analyze two-dimensional geometry using a coordinate system in a variety of situations.

Possible Fifth Grade Indicators

Knowledge Base

The student:

1. explains the relationships among fractions, whole numbers, and where they appear on a number line.
2. maps paths between locations and compares lengths of different paths on a coordinate grid.

Application

The student:

1. uses coordinate grids to formulate and solve real-world problems involving distance and location.

Fourth Grade Benchmark: The student relates geometric concepts to the number line and the first quadrant of the coordinate plane in a variety of situations.

Fourth Grade Indicators

Knowledge Base

The student:

1. uses the number line to represent the distance between two whole numbers.
2. graphs and identifies points in the first quadrant of the coordinate plane.
3. uses points on coordinate grids to identify locations.

Application

The student:

NΔ 1. uses coordinate grids and maps to formulate and solve real world problems involving distance and location such as identifying locations and giving or following directions to move from one location to another.
For the purpose of assessing this indicator on the Kansas Assessment the student should be able to use maps and grids which have positive whole number or letter coordinates.

Possible Third Grade Indicators

Knowledge Base

The student:

1. identifies points in the first quadrant of the coordinate plane.
2. uses two numbers or a letter and a number to identify points on a coordinate grid.

Application

The student:

1. uses coordinate grids to formulate and solve real-world problems, such as identifying locations and giving or following directions to move from one location to another.

Δ This indicator will be assessed at the state level.
N The use of calculators, abacuses or computers will not be allowed during the assessment of this indicator at the state level.
Indicators are not listed in priority order, nor are they considered as all inclusive.

Standard: The student uses geometric concepts and procedures in a variety of situations.

Second Grade Benchmark: *The student identifies one or more points on a simple coordinate system (number line or grid) in a variety of situations.*

Second Grade Indicators

Knowledge Base

The student:

1. uses the number line to represent the distance between two whole numbers.
2. uses a number line to model addition and subtraction.
3. places or locates whole numbers to 1,000 on a number line.

Application

The student:

1. uses the number line to formulate and solve real-world problems.

Possible First Grade Indicators

Knowledge Base

The student:

1. places or locates whole numbers to 100 on a number line.
2. uses the number line to model addition or for counting.

Application

The student:

1. uses the number line to formulate and solve real-world problems.

Possible Kindergarten Indicators

Knowledge Base

The student:

1. places whole numbers one through twenty on a number line.

Application

The student:

1. uses the number line to formulate and solve real-world problems.

Δ This indicator will be assessed at the state level.
N The use of calculators, abacuses or computers will not be allowed during the assessment of this indicator at the state level.
Indicators are not listed in priority order, nor are they considered as all inclusive.

Standard: The student uses concepts and procedures of data analysis in a variety of situations.

Tenth Grade Benchmark: *The student applies probability theory to analyze the validity of arguments, draw conclusions, and make decisions in a variety of situations.*

Tenth Grade Indicators

Knowledge Base

The student:

1. recognizes a distribution that is approximately normal.
2. recognizes and calculates the probabilities associated with the normal curve.
3. calculates probability involving two independent events.
4. calculates conditional probability involving two events.
5. uses permutations and combinations to determine the number of possible outcomes of an event.

Δ 6. explains the relationship between probability and odds, and computes one given the other.

Application

The student:

Δ 1. uses theoretical or experimental probability to make predictions about real-world events such as work in economics, quality control, genetics, meteorology and other areas of science, games, and situations involving geometric probability.
For the purpose of assessing this indicator on the Kansas Assessment, the student should be able to use geometric probability, percentages derived from actual or simulated events, and determine the probability of a simple event or a compound event composed of two or more simple, independent events.

2. conducts experiments and/or simulations, records the results in charts, tables or graphs, and uses the results to draw conclusions and make predictions.
3. compares theoretical (expected) results with empirical (experimental) results.
4. uses conditional probabilities to make decisions.

Possible Eighth Grade Indicators

Knowledge Base

The student:

1. knows and explains the difference between independent and dependent events.
2. identifies situations involving independent or dependent events.
3. calculates the odds of a desired outcome in a simple experiment.

Application

The student:

1. conducts experiments and/or simulations, records the results in charts, tables or graphs, and uses the results to draw conclusions and make predictions.
2. compares theoretical (expected) results with empirical (experimental) results.

Δ This indicator will be assessed at the state level.
N The use of calculators, abacuses or computers will not be allowed during the assessment of this indicator at the state level.
Indicators are not listed in priority order, nor are they considered as all inclusive.

Standard: The student uses concepts and procedures of data analysis in a variety of situations.

Seventh Grade Benchmark: The student uses probability to generate convincing arguments, draw conclusions, and make decisions in a variety of situations.

Seventh Grade Indicators

Knowledge Base

The student:

1. determines the probability of a compound event composed of two independent events.
2. explains and gives examples of events having probability of one or zero.

Δ 3. describes probability of events using fractions, decimals and percents.
For the purpose of assessing this indicator on the Kansas Assessment the student should be able to determine the probability of a simple event or a compound event composed of two simple, independent events.

Application

The student:

1. conducts experiments and/or simulations, records the results in charts, tables or graphs, and uses the results to draw conclusions and make predictions.
2. compares theoretical (expected) results with empirical (experimental) results.
3. makes predictions based on theoretical probabilities of compounded events.

Possible Sixth Grade Indicators

Knowledge Base

The student:

1. lists all possible outcomes for a compound event composed of two independent events in an organized way and recognizes whether an outcome is certain, impossible, likely or unlikely.
2. describes probability of simple events using fractions.

Application

The student:

1. conducts experiments and/or simulations, records the results in charts, tables, or graphs, and uses the results to draw conclusions and make predictions.
2. compares what should happen (theoretical/expected results) with what did happen (experimental/empirical results) in a simple experiment.

Possible Fifth Grade Indicators

Knowledge Base

The student:

1. lists all possible outcomes of a single event in a clear and organized manner.
2. recognizes simple experiments where the probabilities of all outcomes are equal.

Application

The student:

1. conducts experiments and/or simulations, records the results in charts, tables or graphs, and uses the results to draw conclusions and make predictions.
2. compares what should happen (theoretical/expected results) with what did happen (experimental/empirical results) in a simple

Δ This indicator will be assessed at the state level.
N The use of calculators, abacuses or computers will not be allowed during the assessment of this indicator at the state level.
Indicators are not listed in priority order, nor are they considered as all inclusive.

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experiment.

Standard: The student uses concepts and procedures of data analysis in a variety of situations.

Fourth Grade Benchmark: *The student uses probability to make predictions and decisions in a variety of situations.*

Fourth Grade Indicators

Knowledge Base

The student:

1. lists the possible outcomes of a simple experiment.
2. identifies the probability of a single event within a simple experiment such as three chances out of eight.

Application

The student:

NΔ 1. compares what should happen (theoretical/expected results) with what did happen (experimental/empirical results) in a simple experiment.

2. conducts simple experiments and/or simulations involving a single event, records the results in charts, tables, or graphs, and uses the results to draw conclusions about the event and make predictions about future events.

Possible Third Grade Indicators

Knowledge Base

The student:

1. lists some of the possible outcomes of a simple experiment.
2. recognizes whether the outcome of an event is impossible, certain, likely, or unlikely.

Application

The student:

1. conducts experiments and simulations involving a simple event, records the results in a chart, table or graph, and uses the results to draw conclusions about the event.

Δ This indicator will be assessed at the state level.
N The use of calculators, abacuses or computers will not be allowed during the assessment of this indicator at the state level.
Indicators are not listed in priority order, nor are they considered as all inclusive.

Standard: The student uses concepts and procedures of data analysis in a variety of situations.

Second Grade Benchmark: The student uses probability to make predictions and decisions in a variety of situations.

Second Grade Indicators

Knowledge Base	Application
The student: 1. lists some of the possible outcomes of a simple experiment. 2. recognizes and explains whether outcomes of a simple event are equally likely to occur.	The student: 1. conducts experiments and simulations involving a simple event, records the results in charts, tables or graphs, and uses the results to draw conclusions about the event.

Possible First Grade Indicators

Knowledge Base	Application
The student: 1. recognizes whether an outcome of a simple experiment is possible or impossible.	The student: 1. conducts experiments and simulations involving a simple event and tallies the results.

Possible Kindergarten Indicators

Knowledge Base	Application
The student: 1. investigates, recognizes, and explains why a simple experiment can have more than one outcome.	The student: 1. conducts experiments and simulations involving a simple event and tallies the results.

A This indicator will be assessed at the state level.
N The use of calculators, abacuses or computers will not be allowed during the assessment of this indicator at the state level.
Indicators are not listed in priority order, nor are they considered as all inclusive.

Standard: The student uses concepts and procedures of data analysis in a variety of situations.

Tenth Grade Benchmark: The student generates, organizes, and interprets real number and other data in a variety of situations.

Tenth Grade Indicators

Knowledge Base

The student:

1. organizes, displays and reads quantitative (numerical) and qualitative (non-numerical) data in a clear, organized and accurate manner including the use of correct titles, labels, and intervals or categories. Specific formats for data displays include:
   - frequency distributions.
   - box-and-whiskers plots.
   - stem-and-leaf plots.
   - histograms.
   - scatterplots or other discrete graphs.
   - bar, line, and circle graphs.
   - Venn diagrams or other pictorial displays.
   - charts and tables.
2. calculates and explains the measures of dispersion (standard deviation and range) for a real number data set given the appropriate formulas.
3. calculates and explains the meaning of quartiles, percentiles, and interquartile range for a real number data set.
4. explains the affects of outliers on the measures of central tendency and measures of dispersion of a real number data set.
5. approximates a line of best fit given a scatter plot, and makes predictions using the equation of that line.
6. calculates and explains the variance for a real data set given the appropriate formula.
7. explains how the reader's bias, measurement errors, and display distortion can affect the interpretation of data.

Application

The student:

1. determines or explains appropriate sampling techniques for gathering data for a given situation (observation, survey, census of total population, random sampling, sampling of specific groups, etc.).

Δ 2. uses data analysis to make accurate inferences, decisions/predictions, and to develop convincing arguments from data displayed in a variety of formats. (see listing of graphical displays)

For the purpose of assessing this indicator on the Kansas Assessment the student should be able to:

a) use any of the following data displays:
- *frequency distributions.*
- *box-and-whiskers plots.*
- *stem-and-leaf plots.*
- *histograms.*
- *scatterplots or other discrete graphs.*
- *bar, line, and circle graphs.*
- *Venn diagrams or other pictorial displays.*
- *charts and tables.*

b) use any of the following statistical measures - measures of central tendency (mean, median, mode), the range, quartiles, and interquartile range.

c) explain the affects of outliers on the mean, median, and range of a real number data set.

d) approximate a line of best fit given a scatter plot, and make predictions using the equation of that line.

(continued on next page)

Δ This indicator will be assessed at the state level.
N The use of calculators, abacuses or computers will not be allowed during the assessment of this indicator at the state level.
Indicators are not listed in priority order, nor are they considered as all inclusive.

Standard: The student uses concepts and procedures of data analysis in a variety of situations.

Tenth Grade Benchmark: The student generates, organizes, and interprets real number and other data in a variety of situations.

Tenth Grade Indicators (continued)

Δ 3. recognizes or explains the affects of scale and/or interval changes on graphs of data sets.
For the purpose of assessing this indicator on the Kansas Assessment the student should be able to use any of the following data displays:
frequency distributions.
box-and-whiskers plots.
stem-and-leaf plots.
histograms.
scatterplots or other discrete graphs.
bar, line, and circle graphs.
Venn diagrams or other pictorial displays.
charts and tables.

4. determines the advantages and disadvantages of using various statistical measures to describe a data set.
5. analyzes the affects of data transformations on various statistical measures.
6. uses properties of the normal curve to make inferences about data sets that are assumed to be normally distributed.

Δ This indicator will be assessed at the state level.
N The use of calculators, abacuses or computers will not be allowed during the assessment of this indicator at the state level.
Indicators are not listed in priority order, nor are they considered as all inclusive.

Standard: The student uses concepts and procedures of data analysis in a variety of situations.

Tenth Grade Benchmark: *The student generates, organizes, and interprets real number and other data in a variety of situations.*

Possible Eighth Grade Indicators

Knowledge Base

The student:

1. organizes, displays and reads quantitative (numerical) and qualitative (non-numerical) data in a clear, organized and accurate manner including the use of correct titles, labels, and intervals or categories. Specific formats for data displays include:
   - frequency distributions.
   - box-and-whiskers plots.
   - stem-and-leaf plots.
   - histograms.
   - scatterplots.
   - bar, line, and circle graphs.
   - Venn diagrams or other pictorial displays.
   - charts and tables.
2. calculates and explains the measures of central tendency (mean, median, mode) for a real number data set.
3. calculates or explains the range, quartiles, and interquartile range for a real number data set.
4. makes a scatterplot and draws a line that approximately represents the data.
5. explains the affects of outliers on the mean, median, and range of a real number data set.
6. recognizes valid and invalid sampling techniques.

Application

The student:

1. explains advantages and disadvantages of various sampling techniques for gathering data for a given situation (observation, survey, census of total population, random sampling, etc.)
2. uses data analysis to make accurate inferences, decisions/predictions, and to develop convincing arguments from data displayed in a variety of formats. (see listing of graphical displays)
3. uses changes in scales, intervals or categories to help support a particular interpretation of the data.

A This indicator will be assessed at the state level.
N The use of calculators, abacuses or computers will not be allowed during the assessment of this indicator at the state level.
Indicators are not listed in priority order, nor are they considered as all inclusive.

Standard: The student uses concepts and procedures of data analysis in a variety of situations.

Seventh Grade Benchmark: *The student generates, organizes, and interprets rational number and other data in a variety of situations. The student applies measures of central tendency when drawing conclusions from the data.*

Seventh Grade Indicators

Knowledge Base

The student:

1. organizes, displays and reads quantitative (numerical) and qualitative (non-numerical) data in a clear, organized and accurate manner including the use of correct titles, labels, and intervals or categories. Specific formats for the display of rational number data and other types of data include:
   - frequency distributions.
   - box-and-whiskers plots.
   - stem-and-leaf plots.
   - scatterplots.
   - bar, line, and circle graphs.
   - Venn diagrams or other pictorial displays.
   - charts and tables.
2. explains and conducts appropriate sampling techniques for gathering data for a given situation (observation, survey, census of total population, random sampling, etc.)

Δ 3. determines the measures of central tendency (mean, median, and mode), and the range for a rational number data set containing an even or odd number of data points.

4. identifies or determines the quartiles of a data set.
5. determines and explains the advantages and disadvantages of using each measure of central tendency and the range to describe a data set.

Application

The student:

Δ 1. uses data analysis to make accurate inferences, decisions/predictions, and to develop convincing arguments from data displayed in a variety of formats. (see listing of graphical displays)
For the purpose of assessing this indicator on the Kansas Assessment the student should be able to:
a) work with the following data displays.
- *frequency distributions.*
- *box-and-whiskers plots.*
- *stem-and-leaf plots.*
- *scatterplots.*
- *bar, line, and circle graphs.*
- *Venn diagrams or other pictorial displays.*
- *charts and tables.*

b) use any of the following statistical measures: measures of central tendency (mean, median, and mode), quartiles, and the range for a rational number data set containing an even or odd number of data points.
c) use various scales and formats to display the same data set.

2. recognizes or explains the affects of scale and/or interval changes on graphs of data sets.
3. recognizes and explains misleading representations of data.
4. recognizes faulty arguments or common errors in data analysis.

Δ This indicator will be assessed at the state level.
N The use of calculators, abacuses or computers will not be allowed during the assessment of this indicator at the state level.
Indicators are not listed in priority order, nor are they considered as all inclusive.

Standard: The student uses concepts and procedures of data analysis in a variety of situations.

Seventh Grade Benchmark: *The student generates, organizes, and interprets rational number and other data in a variety of situations. The student applies measures of central tendency when drawing conclusions from the data.*

Possible Sixth Grade Indicators

Knowledge Base

The student:

1. organizes, displays and reads quantitative (numerical) and qualitative (non-numerical) data in a clear, organized and accurate manner including the use of correct titles, labels, and intervals or categories. Specific formats for the displays of rational number data and other types of data include:
   - frequency distributions.
   - stem-and-leaf plots.
   - scatterplots.
   - bar, line, and circle graphs.
   - Venn diagrams or other pictorial displays.
   - charts and tables.
2. conducts and explains sampling techniques (observations, surveys, random sampling) for gathering data.
3. determines the mean, mode and range for a whole number data set.
4. determines the median for a rational number data set containing an odd number of data points.

Application

The student:

1. uses data analysis to make accurate inferences, decisions/predictions, and to develop convincing arguments from data displayed in a variety of formats. (see listing of graphical displays)
2. recognizes or explains the affects of scale and/or interval changes on graphs of whole number data sets.
3. explains advantages and disadvantages of using various display formats for a specific data set.

A This indicator will be assessed at the state level.
N The use of calculators, abacuses or computers will not be allowed during the assessment of this indicator at the state level.
Indicators are not listed in priority order, nor are they considered as all inclusive.

Standard: The student uses concepts and procedures of data analysis in a variety of situations.

Seventh Grade Benchmark: *The student generates, organizes, and interprets rational number and other data in a variety of situations. The student applies measures of central tendency when drawing conclusions from the data.*

Possible Fifth Grade Indicators

Knowledge Base

The student:

1. organizes, reads, and displays numerical (quantitative) and non-numerical (qualitative) data in a clear, organized, and accurate manner including correct titles, labels, and intervals or categories. Specific formats for the display of numerical and categorical data include:
   - frequency distributions.
   - stem-and-leaf plots.
   - bar, line and circle graphs
   - Venn diagrams or other pictorial displays.
   - charts and tables.
2. conducts, and explains sampling techniques (observations, surveys, random sampling) for gathering data.
3. ranks the values of a numerical data set containing simple fractions and decimals, identifies maximum and minimum data values, and calculates the range for a data set.
4. calculates and explains the mean (average) for a whole number data set.
5. calculates and explains the median for a whole number data set containing an even number of data points.
6. determines and explains the mode(s).

Application

The student:

1. uses data analysis to make accurate inferences, decisions/predictions, and to develop convincing arguments from data displayed in a variety of formats. (see listing of graphical displays)
2. recognizes or explains the affects of scale and/or interval changes on graphs of whole number data sets.
3. recognizes that the same data set can be displayed in a variety of formats and discusses why a particular format may be more appropriate than another.

A This indicator will be assessed at the state level.
N The use of calculators, abacuses or computers will not be allowed during the assessment of this indicator at the state level.
Indicators are not listed in priority order, nor are they considered as all inclusive.

Standard: The student uses concepts and procedures of data analysis in a variety of situations.

Fourth Grade Benchmark: The student generates, organizes, and interprets whole number and other data in a variety of situations.

Fourth Grade Indicators

Knowledge Base

The student:

NΔ 1. organizes, displays and reads numerical (quantitative) and non-numerical (qualitative) data in a clear, organized and accurate manner including correct titles, labels, categories or whole number intervals.
For the purpose of assessing this indicator on the Kansas Assessment the student should know, explain, or use any of the following data displays:
frequency tables.
horizontal and vertical bar graphs.
Venn diagrams or other pictorial displays.
charts and tables.
line graphs.
pictographs.

2. determines and conducts sampling techniques (observations, surveys, random sampling) for gathering data.

NΔ 3. identifies, explains or calculates the following statistical measures of a data set composed of whole number data values: maximum value, minimum value, range, mean (average) when the data set has a whole number mean, the median for a data set having an odd number of data points and the mode for any data set.

Application

The student:

NΔ 1. uses data analysis to make reasonable inferences, decisions/predictions, and to develop convincing arguments from data displayed in a variety of formats. (see listing of graphical displays)
For the purpose of assessing this indicator on the Kansas Assessment the student should be able to:
a) work with any of the following data displays:
frequency tables.
horizontal and vertical bar graphs.
Venn diagrams or other pictorial displays.
charts and tables.
line graphs.
pictographs.
b) use any of the following statistical measures of a whole number data set: maximum value, minimum value, range, mode, mean (average) when the data set has a whole number mean, and the median for a data set having an odd number of data points.
c) use various scales and formats to display the same data set.

2. recognizes or explains the affects of scale and/or interval changes on graphs of whole number data sets.

3. recognizes that the same data set can be displayed in a variety of formats (i.e. Different display formats for the same data set can look different, but still be the same data set.)

Δ This indicator will be assessed at the state level.
N The use of calculators, abacuses or computers will not be allowed during the assessment of this indicator at the state level.
Indicators are not listed in priority order, nor are they considered as all inclusive.

Standard: The student uses concepts and procedures of data analysis in a variety of situations.

Fourth Grade Benchmark: The student generates, organizes, and interprets whole number and other data in a variety of situations.

Possible Third Grade Indicators

Knowledge Base

The student:

1. organizes, displays and reads numerical (quantitative) and non-numerical (qualitative) data in a clear, organized and accurate manner including correct titles, labels, categories or whole number intervals. Specific graphical displays of whole number, monetary unit, and categorical data include:
   - frequency tables.
   - horizontal and vertical bar graphs.
   - Venn diagrams and other pictorial displays.
   - charts and tables.
   - line graphs.
   - pictographs.
2. knows, explains, and conducts sampling techniques (observations, polls, tally marks, and interviews) for gathering data.
3. ranks the values of a data set containing whole numbers.
4. identifies mode for a data set containing whole numbers.
5. calculates the range for a whole number data set.

Application

The student:

1. uses data analysis to make reasonable inferences, predications, answer questions, and make decisions from data displayed in a variety of formats. (See listing of graphical displays.)
2. recognizes that the same data set can be displayed in a variety of formats. (i.e. Different display formats for the same data set can look different, but still be the same data set.)

Δ This indicator will be assessed at the state level.
N The use of calculators, abacuses or computers will not be allowed during the assessment of this indicator at the state level.
Indicators are not listed in priority order, nor are they considered as all inclusive.

Standard: The student uses concepts and procedures of data analysis in a variety of situations.

Second Grade Benchmark: The student collects, displays, and explains whole number and other data in a variety of situations.

Second Grade Indicators

Knowledge Base

The student:

1. organizes, displays and reads, numerical (quantitative) and non-numerical (qualitative) data in a clear, organized and accurate manner including correct titles, labels, categories or whole number intervals (includes knowing the importance of using the same size pictures or intervals to ensure the information is conveyed accurately at a glance). Specific graphical displays of whole number, monetary unit, and categorical data include:
   - frequency tables using tally marks.
   - graphs using concrete materials.
   - bar graphs.
   - Venn diagrams and other pictorial displays.
2. knows, explains, and conducts sampling techniques (observations, polling, tallying, and interviews) for gathering data.
3. identifies the largest and smallest data value.
4. identifies the mode for a data set containing up to two-digit whole numbers or identifies the category which occurs most often.

Application

The student:

1. describes the results of data investigations and answers questions which are posed.
2. recognizes appropriate conclusions generated from the data collected and begins to recognize inappropriate descriptions of the data set.
3. recognizes that the same data set can be displayed in a variety of formats (i.e. Different display formats for the same data set can look different, but still be the same data set).

A This indicator will be assessed at the state level.
N The use of calculators, abacuses or computers will not be allowed during the assessment of this indicator at the state level.
Indicators are not listed in priority order, nor are they considered as all inclusive.

Standard: The student uses concepts and procedures of data analysis in a variety of situations.

Second Grade Benchmark: The student collects, displays, and explains whole number and other data in a variety of situations.

Possible First Grade Indicators

Knowledge Base

The student:

1. displays and reads data in a clear and organized manner using correct titles. Specific graphical displays of whole numbers, monetary units, and categorical data include:
   - frequency tables using tally marks.
   - graphs using concrete materials.
   - bar graphs.
   - Venn diagrams or other pictorial displays.
   - pictographs with the symbol or picture representing only one.
2. conducts different sampling techniques (observations, polls, tally marks, and interviews).
3. determines the set with the most (mode) after sorting by an attribute.
4. sorts and records qualitative data (non-numerical, categorical) sets using one attribute.

Application

The student:

1. describes the results of data investigations and orally answers questions which are posed, such as identifying more, less, fewer, greater than, or less than from the information on a bar graph or pictograph.
2. begins to determine categories from which data could be gathered, such as shoe size, height, color of eyes, etc.

Standard: The student uses concepts and procedures of data analysis in a variety of situations.

Second Grade Benchmark: The student collects, displays, and explains whole number and other data in a variety of situations.

Possible Kindergarten Indicators

Knowledge Base

The student:

1. gathers data relating to familiar experiences by counting and tallying.
2. displays information using objects and pictorial graphs and tables. Specific graphical displays of whole number and categorical data include:
   - frequency tables using tally marks.
   - graphs using concrete materials.
   - pictographs (with symbol or picture representing only one).

Application

The student:

1. describes the results of data collection orally, such as six children have red shoes and ten children have black shoes.

A This indicator will be assessed at the state level.
N The use of calculators, abacuses or computers will not be allowed during the assessment of this indicator at the state level.
Indicators are not listed in priority order, nor are they considered as all inclusive.

Appendix 1

Additional Information on Mathematical Communication, Reasoning, and Problem Solving

Mathematical Communication

Communicating mathematically means mathematical vocabulary, language, notation, and symbols are used to express or interpret mathematical concepts, procedures, and relationships. Problems which emphasize mathematical communication ask students to express or interpret mathematical ideas in a variety of written, oral or visual formats.

A student who demonstrates strong mathematical communication skills:

1. uses accurate vocabulary, notation, and symbolism to express or interpret mathematical facts, concepts, and procedures.
2. correctly expresses mathematical facts, concepts, and procedures in symbolic, verbal (oral and written), pictorial and/or graphical form.
3. correctly interprets mathematical facts, concepts, and procedures when presented in symbolic, verbal (oral and written), pictorial, and/or graphical form.
4. translates between concrete, pictorial, graphical, symbolic, verbal or mental representations of mathematical facts, concepts, and procedures.
5. recognizes or describes mathematical facts, concepts or procedures.
6. determines if representations of mathematical facts, concepts, and procedures are presented in an accurate, clear, and unambiguous format.

Mathematical Reasoning

Mathematical reasoning is defined as the ability to make selective judgments by forming generalizations and drawing valid conclusions about mathematical ideas and how they are related. Problems which emphasize mathematical reasoning ask students to make mathematical inferences by integrating their mathematical understanding with the data presented in order to determine one or more mathematical solutions.

A student who demonstrates strong mathematical reasoning skills:

1. draws valid conclusions, generalizes patterns or forms a general rule from a set of facts or information involving mathematical facts, concepts, and procedures. (inductive reasoning)
2. draws specific and valid conclusions from one or more mathematical facts, concepts, and procedures. (deductive reasoning)
3. determines and explains how a change to one real number ratio in a proportion affects the other real number ratio. (proportional reasoning)
4. describes the physical characteristics (such as size, shape or capacity) and/or location of objects when viewed from one or more geometric perspectives. (spatial reasoning)
5. formulates examples and counterexamples using mathematical facts, concepts, and procedures.
6. verifies the validity of conclusions (either the student's own or someone else's conclusions) using mathematical facts, concepts, and procedures.
7. understands the concepts of and develops both formal and informal proof through understanding the difference between a statement verified by mathematical proof (i.e. a theorem) and a statement verified empirically using examples or data.

Special Note:

Algebraic reasoning can be defined as either inductive or deductive reasoning using algebraic expressions, functions, graphs, equations and other algebraic facts.

Geometric reasoning can be defined as either inductive or deductive reasoning using geometric properties, symbols, figures, and other geometric facts.

Quantitative reasoning can be defined as either inductive or deductive reasoning using numerical facts.

Mathematical Problem Solving

Mathematical problem solving is the process by which an individual or group uses previously acquired knowledge, skills, and understandings to satisfy the demands of an unfamiliar situation. This process could include formulating problems, applying a variety of strategies, verifying and interpreting solutions, and generalizing solutions.

A student who demonstrates strong mathematical problem solving skills:

1. formulates questions or problems to be asked regarding a specified situation or data set.
2. finds one or more reasonable and plausible solutions to a given problem situation.
3. demonstrates the understanding of the problem by restating the problem in his/her own words, identifying information which is known, explaining the mathematical language used in the problem, and/or identifying additional conditions or restrictions not given in the original statement of the problem.
4. identifies, discusses, and chooses one or more strategies which can be implemented in order to find a solution to a given problem situation.
5. implements one or more strategies which has (have) been identified as a way to find a solution to a given problem situation.
6. reviews and revises the original problem identification, strategy selection, strategy implementation, and/or reporting of the solution to a problem situation if the reported solution does not seem reasonable.
7. explains the advantages and disadvantages of various strategies which could be used to provide a solution to a problem situation.
8. explains the advantages and disadvantages of various solutions to a problem situation.
9. recognizes or explains a process which was used to solve a problem situation.

Special Note: For the purpose of assessing application indicators on the Kansas Assessment which ask the student to formulate and solve real-world problems, the student should be able to perform one or more of the skills listed in numbers one through five.

Appendix 2

Selected Bibliography

Members of the Mathematics Standards Writing Committee used many sources for information and research on the teaching and learning of mathematics in the consideration of contents of this document. Curriculum documents from several states and Japan were consulted along with national reviews of the current *Kansas Curriculum Standards for Mathematics* and materials from various national publishers . Listed below is a representative sample of the various materials used by the Kansas Mathematics Standards Writing Committee in their work.

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Appendix 3

Glossary of Terms

The following vocabulary words form a partial list of the correct mathematical terms which teachers are expected to include for students during grades K-5. These terms should be introduced as soon as it is appropriate and then constantly reinforced throughout these years so that all students have mastered these terms by the end of the 5th grade year. For definitions more appropriate for higher levels of mathematics, consult the glossary in your school's mathematics textbooks or consult a mathematics dictionary.

Acute Angle--an angle that measures less than ninety degrees.

Addend--one of a set of numbers to be added.

Addition Problem--

8 (Addend)
+ 4 (Addend)
12 (Sum)

Angle--a figure formed by two rays having a common endpoint.

Approximation--a number that has been rounded off.

Area--the measure of the region inside a closed plane figure, area is measured in square units.

Associate Property--for any real numbers a, b, and c: (a+b)+c=a+(b+c); and for any real numbers a, b, c: (ab)c+a(bc).

Axes--the perpendicular number lines in a coordinate graph from which the coordinates of points are determined.

Capacity--a measurement of the amount that a container can hold.

Celsius--a temperature scale on which zero degrees is the freezing point of water.

Center (of a circle)--the point inside a circle that is the same distance from every point on the curve.

Certain event--an event with a probability of one.

Chart--sheet of information arranged in lists, pictures, tables, or diagrams.

Chord--a line segment connecting any two points on a circle.

Circle--a close plane curve with every point the same distance from the center.

Circumference--the distance around the outside of a circle.

Clustering--an estimation strategy which groups numbers with relatively the same estimation value, (7,225+6,734+7,123+6,642 to 7,000+7,000+7,000+7,000).

Commutative Property--for any real numbers a and b; a+b=b+a; and ab=ba.

Compass--a tool for drawing circles.

Compatible Numbers--numbers that can easily "fit together" and are easy to manipulate mentally.

Composite Figures--figures made up of several different geometric shapes.

Composite Numbers--numbers that have more than itself and 1 as factors (6 has factors of 1, 2, 3, and 6).

Compound Event--an event composed of at least two simple events.

Cone--a space figure with a circular base and a vertex (like an ice cream cone).

Congruent--figures that are exact "duplicates" of each other.

Coordinate plane--a plane in which every point can be identified by two numbers.

Coordinates--a pair of numbers which give the location of a point on a plane or graph

Cube--a space figure having six congruent, square faces.

Cup--a unit of liquid measure (8 oz.=1 cup).

Customary units--units of measure commonly used in the United States (inches, feet, yards, etc.).

Data--figures, facts or information.

Decimals--a name for a fractional number expressed with a decimal point, such as .27.

Denominator--the number below the line in fraction. (see fraction)

Diagonal--a line segment that joins two vertices of a polygon but is not a side of the polygon.

Diameter--a line segment which has its endpoints on a circle and which passes through the center of the circle.

Difference--the result of subtracting one number from another. (see subtraction)

Digit--the ten digits in our numeration system are: 0,1,2,3,4,5,6,7,8, and 9.

Distributive Property--a law which says a(b+c)=ab+ac [2(3+5)=2•3+2•5]. For all real numbers a, b, and c: ac+bc=(a+b)c and ac-bc=(a-b)c.

Dividend--the number that is being divided by another number.

Divisibility--a number is divisible by a given number if the quotient of the two numbers is a whole number.

Division Problem--

$$\begin{array}{r} \underline{12}\ \text{(quotient)} \\ 4\overline{)48}\ \text{(dividend)} \end{array}$$

(divisor)

Divisor--the number by which the dividend is divided.

Equation--a mathematical sentence which states that two expressions are equal (2+3=1+4).

Equilateral triangle--a triangle whose sides are all congruent.

Equivalent--numbers which have the exact same value (5 is equivalent to 2 + 3).

Estimation Examples--a. Front-end with Adjustment

$1.26
4.79 Add whole number part (left most digit.)
.99 1+4+0+1+2=8
1.37 Adjust by looking at decimal parts.
2.58 .26+.79=1
.99=1
.37+.58=1
3

Therefore, the estimate is 8+3=11

b. Rounding

$4.78
2.93 Round number to nearest whole number.
1.25
3.12 5+3+1+3

Therefore, the estimate is 12.

c. Special Numbers

Examples of special numbers are 1, 10, 100, 1,000, ½, 0.

Estimate by rounding to one of the special numbers.

67 x 102	Estimate 67 x 100 or 6,700
5,421/9.87	Estimate 5,421/10 or 542.1
4/7+12/13	Estimate 1 + ½ or 1½
4,805 x 11/21	Estimate 4805 x ½ or 2,400

d. Clustering

Clustering can be used as an estimation strategy when you have a group of numbers that cluster around a common value.

7225
6734 This set of numbers clusters around 7,000.
6829 A good estimate would be 7000 x 6 or 42,000.
7295
7101
+ 6642

e. Compatible "nice" Numbers

Compatible (nice) numbers are numbers that can easily "fit together" and are easy to manipulate mentally. Take a global look at all numbers, look for numbers that can be paired for easy computation.

27
49 27+81=100
38 49+56=100
56 38+65=100
81
+ 65 Therefore, the estimate is 300.

f. Truncation

Truncation is the process of ignoring all digits to the right of a chosen place value. An example of using truncation as an estimation technique is saying gasoline sells for $1.13 per gallon when the actual price is $1.139 ($1.13^9$).

Even number--a number that can be divided by 2 with no remainder (2, 4, 6, 8, 10, ...).

Exponents--a numeral telling how many times a number is to be multiplied by itself.

Factor--one of two or more numbers that are multiplied to get an answer (in 3 x 4 = 12, both the 3 and the 4 are known as factors of 12.)

Fahrenheit--a customary unit of measurement used to measure temperature where the freezing point of water is 32 degrees.

First Quadrant--the upper right hand fourth of a plane. (see quadrant)

Foot--a unit of length (12 in. = 1 foot).

Fraction--a part of a whole, the name for a fractional number written in the form a/b (4/9).

Numerator-- the number above the line in fraction. 4 (numerator)
Denominator--the number below the line in fraction. 7 (denominator)

Improper Fraction--a fraction with a numerator larger than a denominator (7/3).

Proper Fraction--a fraction with a numerator smaller than a denominator (3/7).

Mixed Number--a number greater than 1, such as 5 1/2, that has a whole number and a fraction

Lowest terms--a fraction written so that the numerator and denominator have 1 as the only common factor (4/7 is in lowest terms but 8/14 is not since 2 will go into both the numerator and the denominator, i.e., 2 is a common factor).

Reduce or Simplify--to write a fraction in lowest terms.

Frequency--the number of times an event occurs.

Front-end with adjustment--rounding to the nearest whole number such as ($4.96 +$5.88 to $5.00 + $6.00).

Function--a special set of ordered pairs.

Gallon--a unit of liquid measure (4 quarts =1 gallon).

Greater than--symbol used for comparing two numbers (>).

Greatest Common Factor--the greatest number that is a common factor of two or more numbers (6 is the GCF of 12 and 18 because it is the largest number that goes into both 12 and 18).

Grid--a set of horizontal and vertical lines spaced uniformly used to graph points.

Hexagon--a six-sided plane figure.

Impossible event--an event with a probability of zero.

Improper Fraction--a fraction with a numerator larger than a denominator (see fraction).

Inch--a unit of length (1/12 of a foot).

Integer--any member of the set of positive or negative counting numbers and 0 (...-4,-3,-2,-1,0,1,2,3,4...). (adj.: integral)

Intersecting Lines--2 or more lines that cross each other.

Intersection--the point at which two lines meet.

Irrational number--a real number that is not rational. A number than can be written as a non-repeating infinite decimal.

Least Common Multiple--the smallest number that is a common multiple of two or more numbers (24 is the LCM of 6 and 8 because it is the smallest number that both 6 and 8 will go into evenly).

Length--the measure from top to bottom.

Less than--symbol used for comparing two numbers (<).

Line--an infinite straight line that passes through two or more points.

Linear equation--an equation which results in a straight line when graphed.

Mass--a measurement that tells how much of something there is.

Mean--average, the sum of numbers in a set of data divided by the number of pieces of data.

Median--the middle number in a set of numbers, determined by arranging them in order from lowest to highest and counting to the middle.

Metric units--a system of measurement based on the decimal system (meters, centimeters, etc.).

Mile--a unit of length (5,280 feet = 1 mile).

Minuend--the name given to the number from which another number is to be subtracted. (see subtraction)

Mixed Number--a number greater than 1, such as 5 1/2 that has a whole number and a fraction. (see fraction)

Mode--the number found most frequently in a set of data.

Multiplicand--a name given to the number that is being multiplied by another number. (see multiplication)

Multiplication Problem-- 5 (multiplicand or factor)
x 4 (multiplier or factor)
20 (product)

Multiplication Property of Zero--for any real number a: $a \cdot 0 = 0$; $0 \cdot a = 0$

Multiplication Property of One-- for any real number a: $a \cdot 1 = 1$; $1 \cdot a = 1$

Multiple--a number that is the product of a given number and some partner (20 is a multiple of 4 because 4 goes into 20 evenly i.e. 4 and a partner (5) have a product of 20)

Multiplier--the number by which the multiplicand is being multiplied. (see multiplication)

Neighbor--the whole number which is adjacent to another whole number (the neighbors of 6 are 5 and 7).

Number--a mathematical idea contained in a set.

Numeral--the symbolic representation of a number.

Numerator-- the number above the line in fraction. (see fraction)

Obtuse--an angle that measures more than ninety and less than one hundred eighty degrees.

Octagon--an eight sided plane figure.

Odds against an event--the ratio of the number of ways an event **cannot** occur to the number of ways that an event can occur.

Odds for an event--the ratio of the number of ways an event **can** occur to the number of ways that an event cannot occur.

Order of operations--the correct order of evaluating numerical expressions: first, work inside parentheses, then do powers. Then do multiplications or divisions, from left to right. Then do additions or subtractions, from left to right.

Ounce--a measurement of weight (1/16 of a pound).

Outcome--a possible result of an experiment.

Parallel lines--lines in the same plane which do not intersect.

Parallelogram--a four sided plane figure with parallel opposite sides.

Pattern--a repeated sequence.

Pentagon--a five-sided plane figure.

Percent--a comparison of a number with 100, (43 compared to 100 is 43%).

Perimeter--the measurement of the distance around the outside of a figure

Perpendicular--lines in the same plane that intersect at right angles

Pint--a unit of liquid measure (2 cups =1 pint)

Place value--the value assigned to a digit due to its position in a numeral

Plot--locating points on a coordinate grid.

Point--a definite given position.

Poll--a survey of public opinion concerning a particular subject.

Polygon--a simple closed plane figure having line segments as sides.

Pound--a measurement of weight (16 oz. =1 pound).

Prediction--a guess of the number of occurrences in a probability situation; something that is guessed in advance, based on known facts.

Prime Factorization--an expression showing a whole number as the product of prime factors

(24 = 4x6 is not a prime factorization since 4 can be broken down into 2x2 and 6 can be broken into 2x3. The correct prime factorization of 24 is 2x2x2x3.)

Prime Numbers--a positive integer that can be divided by only 1 and itself (2,3,5,7,11.....).

Probability of an event--the likelihood that an event will occur, the number of times something is likely to occur out of a given number of attempts or tries; a number from 0 to 1 that measures the likelihood that an event will occur.

Product--the answer in a multiplication problem (see multiplication).

Proper Fraction--a fraction with a numerator smaller than a denominator. (see fraction)

Proportion--a statement of equality between two ratios. For example, 3:6 = 1:2, read : 3 is to 6 as 1 is to 2, can also be written as two equal fractions 3/6 = 1/2.

Protractor--a tool for measuring and drawing angles.

Pyramid--a conic surface whose base is a polygon and whose other faces are triangles that share a common vertex.

Quadrant--one of the four regions of the coordinate plane formed by the x-axis and y-axis.

Quadrilateral--a four-sided polygon figure.

Quart--a unit of liquid measure (2 pints =1 quart).

Quotient--the answer in a division problem (see division).

Radius--a line segment having one endpoint in the center of the circle and another on the circle.

Range--in a collection of numbers, the difference between the largest number and the smallest number. The length of an interval. The maximum value minus the minimum value.

Ratio--a comparison of two numbers expressed as a fraction.

Rational number--a number than can be written as the ratio of two integers.

Ray--a portion of a line extending from one endpoint in one direction indefinitely.

Rectangle--a four sided plane figure with ninety degree angles and parallel sides.

Regrouping--the process of renaming one place value to another (the number 1 ten to ten ones).

Remainder--the number left over when things are divided into equal shares.

Rhombus--a quadrilateral that has four congruent sides.

Right angle--an angle that measures ninety degrees.

Right triangle--a triangle that has a ninety-degree angle.

Roman Numerals--numerals used by the Romans for keeping records.

Rounding--writing a number to a specific place value so it is easier to work with (round 678 to the nearest ten-680).

Scalene triangle--a triangle that has no congruent sides.

Segment--two points and the part of the straight line that is between them.

Similarity--a property of geometric figures having angles of the same size.

Simple event--a simple event is a subset of all the possible outcomes of a single activity where data is gathered.

Sphere--a space figure formed by a set of points equidistant from a center point (a round ball).

Square--a quadrilateral with four right angles and four congruent sides.

Standard form--the numeric representation of written or pictorial forms of a number concept (one hundred thirty-two=132).

Subtraction Problem--
28 (minuend)
- 7 (subtrahend)
21 (difference)

Subtrahend--the number or the term to be subtracted. (see subtraction)

Sum--the result of adding two or more numbers. (see addition)

Symmetry--a figure that has two halves that are reflections of each other that are divided by a line of symmetry.

Square-- a four-sided plane figure with equal sides and ninety degree angles.

T-Chart--a chart of ordered pairs.

Temperature--the measurement of the absence of heat.

Three-Dimensional--a space figure having height, length, and depth

Ton--a measurement of weight equal to 2,000 pounds.

Transformation--solving equations for any variable.

Transitive--a law of equality which says if a=b, and b=c, then a=c.

Triangle--a polygon with three sides.

Two-Dimensional--a plane figure having only the dimensions of width and length.

Variable--a symbol which represents a numerical value in a number sentence (in the equation 6+a=10, "a" is the variable).

Volume--the measure of capacity or space enclosed by a figure.

Weight--the measure of how heavy an object is.

Whole number--the set of numbers {0, 1, 2, 3, ...}.

200

Width--the measure from side to side.

X-axis--the horizontal axis in a coordinate graph.

Y-axis--the vertical axis in a coordinate graph.

Yard--a unit of length (3 feet = 1 yard).

Zero Product Property--for any real numbers a and b, if ab=0, then a=0 or b=0.

Appendix 4

Helpful Resources

Kansas State Department of Education

If you have any questions regarding this document, the Kansas Mathematics Assessment Program or any portion of the Kansas Mathematics Improvement Program please contact Kim Gattis or any member of the School Improvement and Accreditation Team.

Kim Gattis, KSDE's mathematics consultant can be reached by any of the following methods:

e-mail:	kgattis@ksbe.state.ks.us
phone:	(785) 296-3851
mailing address:	Kim Gattis, Mathematics Consultant Kansas Department of Education 120 S.E. Tenth Ave. Topeka, KS 66612-1182

The Mathematics Homepage on the Kansas State Department of Education website will continue to be developed to provide additional information on the Kansas Curricular Standards for Mathematics, the Kansas Mathematics Assessments, professional development opportunities, links to helpful mathematics education sites, and supplemental documents to support the standards. The KSDE website address is <www.ksbe.state.ks.us>.

National Council of Teachers of Mathematics (NCTM)

The National Council of Teachers of Mathematics is a not-for profit professional and education association dedicated to the improvement of mathematics education. NCTM has developed a variety of resources to assist teachers and school in implementing mathematics education reform. NCTM also publishes four mathematics educational journals. In addition each year NCTM sponsors national and regional professional development activities and conferences.

The National Council of Teachers of Mathematics can be reached by any of the following methods:

website:	www.nctm.org
phone:	(703) 620-9840
mailing address:	National Council of Teachers of Mathematics 1906 Association Drive Reston, VA 22091-1593

Eisenhower National Clearinghouse for Mathematics and Science Education

The mission of the Eisenhower National Clearinghouse (ENC) is to identify effective curriculum resources, create high-quality professional development materials, and disseminate useful information and products to improve K-12 mathematics and science teaching and learning. The Eisenhower National Clearinghouse is pa funded by the U.S. Department of Education The ENC website contains descriptions of various curriculum materials in mathematics and science.

The Eisenhower National Clearinghouse can be reached by any of the following methods:

website:	www.enc.org
phone:	(800) 621-5785
mailing address:	Eisenhower National Clearinghouse The Ohio State University 1929 Kenny Road Columbus, OH 43210-1079

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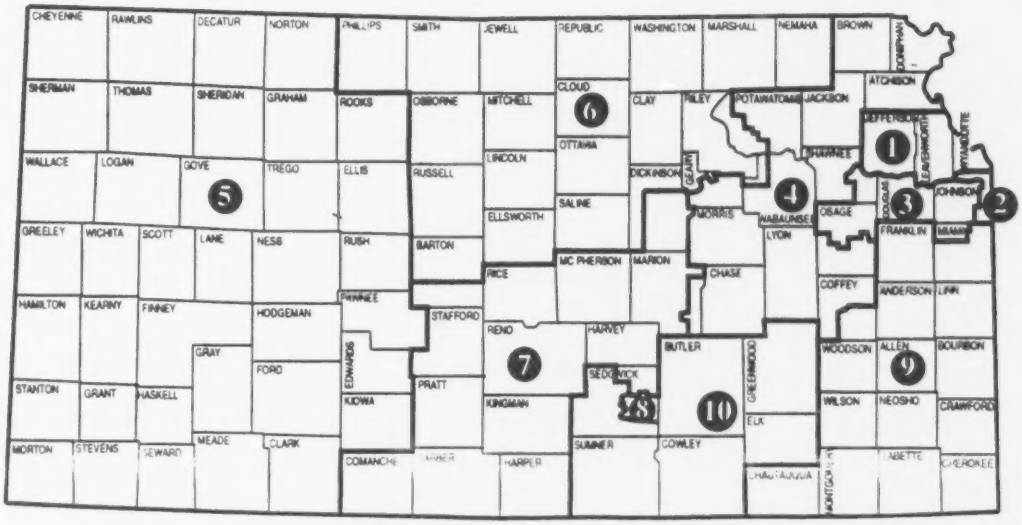
With this in mind the Board has adopted the following mission:

The Kansas State Board of Education promotes student academic achievement by providing educational vision, leadership, opportunity, accountability, and advocacy for all.

The Board believes that focusing on this mission will lead to an educational system which is embodied in the following vision statement:

Schools will work with families and communities to prepare each student with the living, learning, and working skills and values necessary for caring, productive, and fulfilling participation in our changing society.

Kansas State Board of Education
Adopted 2/99



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